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Technical specification and design adequacy calculations

Design Basis

Design capacity : 300 KLD

Operating Hours : 24 hrs

Plant Flow Rate/Phase : 13 m^3 / h r

Design Flow Rate : 13 m^3 / hr

Quality logistics

S.No	Description	Unit	Inlet	Outlet	Standards
1	pH		7 - 8	6.5 – 7.5	6.5 – 8.5
2	TSS	mg/ l	200 – 250	<20	<30
3	BOD	mg/ l	250 – 300	<10	<20
4	COD	mg/ l	400 – 500	<100	<250
5	Oil & Grease	mg/ l	5 – 10	Nil	<5

Process Description

The sewage generated from the various sources will be collected in the collection tank through the screen chamber to remove floating material and particle size greater than 20 mm. The Screened sewage is then led to the aeration tank through Raw Sewage Transfer Pump. Coarse bubble diffusers are provided in the collection tank.

In the aeration tank, air is diffused through special type of diffusers to oxidize the organic matters with the help of air blower & diffuser arrangement. Biological treatment takes place through SBR technology. In the SBR (Sequential Batch Reactor) Oxygen is bubbled through the waste water to reduce biochemical oxygen demand (BOD) and chemical oxygen demand (COD).Then the overflow from SBR tank is sent to the decanting water tank for settling. The bioflocs formed in the SBR tank will be settled at the bottom of the decanting water tank and the settled sludge will be pumped to the sludge holding tank through the return sludge pump. From sludge holding tank, the sludge will be fed to filter press unit for dewatering purpose through screw pumps.

The decanted water from the decanted water tank and then fed to the pressure sand filter, activated carbon filter through filter feed pump for the removal of suspended solids, organic matter, odour and salt of calcium & magnesium (Hardness). The disinfected water is passed in to ultra filtration unit pre discharge to gardening and flushing. Finally, after treatment, the treated water is disinfected using UV disinfection system.

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In this process MLSS concentration in aeration tank will be maintained between 3000 – 3500 mg/L. To maintain this concentration sludge from clarifier will be recirculated to aeration tank. The microorganisms present in the sludge will digest the organic compounds present in the sewage and thus reduces BOD and COD content of the inlet sewage. Oxygen required for the survival of the microorganisms will be supplied through air blower and diffuser arrangements. The other pollutants will be reduced by various treatment steps as given above.

The treated water can be used for flushing & gardening purpose.

Components of STP

- Bar screen chamber
- Equalization/Collection tank
- Pre-Aeration Tank
- SBR (Aeration Tank)
- Decant tank
- Sludge Holding Tank
- Final Treated Water Tank
- UF Treated Water Tank

Bar screen chamber

Sewage generated from the development activity will flow by gravity into the bar Screen Chamber, where bar Screen is fixed to arrest suspended trashy matter such as, paper, rags, vegetable wastes, leaves, cotton waste etc. The bar screens have to be cleaned manually using a hand rake and these screenings to be collected and disposed off at regular intervals to landfill.

Equalization Tank

Sewage free from trashy matters will be collected in the Pre aeration Tank by gravity. The tank acts as a holding tank for the raw effluents in order to homogenize the wastewater quality, control the dampening flow, constant feed water flow rate to rest of the treatment plant etc.

Aeration System (SBR Technology):

The wastewater thus received in the SBR tank is treated by Sequential Batch Process. The reaction in SBR tank takes place in following step.

1. The reactor is allowed to fill with raw wastewater. The filling phase is often divided into stages that include aeration to reduce BOD and to nitrify ammonia and then mixing without aeration to promote de-nitrification. (Removal of nitrogen)
2. A reaction is generally provided to promote additional biological treatment.
3. A settling or quiescent phase the follows to allow biological solids to settle.

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4. A decanting phase is provided to draw off the clarified effluent from upper portion of the reactor

5. Often a small idle phase is provided to allow time for miscellaneous operations that may need to occur to keep the reactors in sequence.

The SBR tank is provided with membrane type air diffusers. The main air header is connected to a rotary lobe type blower, which delivers the required quantum of air to the system. The raising bubbles from the diffusion membranes scrub the water more efficiently causing molecular diffusion and enhance the dissolved oxygen level in the effluent. With organic matter as food and oxygen for respiration, the aerobic bacterial volume increases day by day and starts consuming the organic matter present in the water. In order to keep the bacterial volume high, the aerated water is decanted to separate the bacterial floc and the same is re-circulated to the aeration tank. The raising bubbles from the membrane diffusers also keep the content of the aeration tank in a turbulent mode; thereby causing intimate mixing of bacterial volume and organic matter present in the effluent for more uniform digestion of the organic matter. This would result in uniform residual BOD.

Wasting of biological solids that are produced by converting BOD to bacteria needs to occur periodically to maintain the design mixed liquor concentration and sludge age. Wasting can occur at any die in the process sequence. Frequently, wasting is performed following the decant phase when sludge concentration is highest or during react phase when the sludge concentration is consistent.

The SBR's will be equipped with diffused aeration and decanting facilities. The discharge from SBR systems is higher than the inflow because the same volume of water that entered the SBR is discharged over a shorter time period.

Sludge Disposal

Sludge will be recirculated to SBR tank. The excess sludge will be collected in a separate sump and then feed into a filter press arrangement where the sludge will be thickened. The thickened sludge will be removed from the filter cloths manually and should be dried and used as manure for gardening. The filtrate from filter press will be again sent to equalization tank.

Decant Tank

The SBR final water is passed to the Decant tank. From here the treated water is pumped to the carbon and sand filters, where the suspended solids, colour and odour will be removed.

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Pressure Sand Filter (PSF)

The treated effluent from the sump is pumped to Multigrade sand filter where further reduction in TSS, BOD5, odour and color will takes place. This is a pressure vessel equipped with a perforated under drain plate. Here the sewage will filtered with polystyrene strainers filled with filter media comprising of graded gravel, sand and pebbles. The suspended particulates are arrested and the clean filtered water coming out from the Multigrade sand filter is led to Activated carbon filter for further treatment.

Activated Carbon Filter (ACF)

The filter water from the Multigrade sand filter passes through the activated carbon filter, which is also a vertical pressure vessel. It is also equipped with perforated plate with polystyrene strainers at the bottom and top perforated brass strainers. In between is the filter media comprising of 900-1000 mm activated carbon granules over a bed of graded gravel.

In ACF any odour and to certain extent colour in the waste water is absorbed by the carbon and the filter water is absolutely sparklingly clear.

- The backwash for ACF and PSF will be carried for 2 times per day and the generation of water will be again recirculated to equalization tank.
- The Disposal of filter media from ACF, PSF will be tightly packed and resold out.

UV Disinfection system

The filtered water is treated in UV disinfection system where the water undergoes treatment with UV radiation to get rid of pathogens present in the water. The treated water is sent for gardening and the remaining is sent to UF.

Ultra filtration

The treated wastewater will be then passed to ultra filtration for complete reduction of Total suspended solids, microbes and color of the water, since the wastewater is utilized for the flushing purposes; we need the treated water quality in Nil TSS and BOD less than 10 mg/l.

The STP treated water is pumped to Bag Filter for finer filtration and it is taken to the UF membrane where high molecular weight substances, colloidal materials, and organic and inorganic polymeric molecules are removed. The Product Water is taken to Product water Storage tank and Reject is led into drain.

The UF system comprises of UF membranes housed in FRP pressure tube. All interconnecting pipe lines in UPVC & Pneumatic Hoses. Necessary instrumentation is provided to monitor the operation of the system.

Almost all components/equipments of the UF unit will be pre-engineered, pre-wired, pre-tested and ready for use after giving necessary interconnections. The UF block will be totally

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skid mounted. Each unit will be a product of high quality workmanship, skilled and experienced mechanical design.

- The backwash water from Ultra filtration unit will be again recirculated to collection tank.
- The Disposal of membrane from UF will be tightly packed and disposed to Hazardous waste authorized vendor.

Treated water Tank

The clear water from UF is collected in a treated tank and used for flushing and remaining water is disposed through local body. This water is generally have desired characteristics required for water to be used on irrigation land with 92-95% of BOD5 removed.

Adequacy Evaluation of the Sewage Treatment Plant

SPECIFICATION OF BAR SCREEN CHAMBER

Adequacy Calculation

Size of bar screen chamber	: 0.9m x 0.9m x 1m
No. of bar screen chamber	: 1
MOC	: RCC

SPECIFICATION OF EQUALISATION/COLLECTION TANK

Adequacy Calculation

Size of the Collection Tank	: 7.5 m x 6.1 m x 3.5 m (SWD)
No. of tank	: 1
Volume of the Collection Tank, V	: 160 m^3
Flow Rate, Q	: 13 m^3 / hr
Retention Time	: 160/13
	: 12 hours

Standard Retention hours for Collection Tank is 8-12 hrs

Provided Retention hours is = or > standard retention hours.

Hence it is adequate

SPECIFICATION OF PRE-AERATION TANK

Adequacy Calculation

Size of the Pre-Aeration Tank	: 21.2 sq.m x 3.7 m (SWD)
No. of tank	: 1
Volume of the Pre-Aeration Tank, V	: 78 m^3

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Flow Rate, Q : 13 m^3 / hr

Retention time : 78/13

: 6 hours

Hence it is adequate

SPECIFICATION OF SBR TANK

Adequacy Calculation

Design flow : 300 KLD

No of reactor : 1

No of cycle : 4

Period of each cycle : 5 hours

Fill & reaction Period for each cycle : 3 hour

Settling Period in each cycle : 1 hour

Decanting Period in each cycle : 1 hour

Volume sewage to be Treated per cycle : 300/4= 75 Cu.m

Volume required for SBR tank : 75*2.5 = 187.5 cum

Size of the SBR Tank : 53.9 sq.m x 3.4 m (SWD)– 1 Nos

Provided Volume of the SBR Tank, V : 183 m^3

Provided volume of the SBR Tank is equal to the required volume.

Hence ok

SPECIFICATION OF AIR BLOWER

Adequacy Calculation

Assume O_2 requirement : 2kg of O_2/ 1kg of BOD

: 1 kg of BOD / 2 kg of O_2

Assume BOD for sewage : 300 mg/l = 0.3 kg / m^3

BOD Load : 300 x 0.3 = 90 kg of BOD / day

O_2 requirement : 90 x 2 = 180 kg of O_2 / day

Oxygen transfer @ 16% of SOTR : 180 / (0.16 x 0.23 x 0.65 x 0.95)

: 180 / 0.0227 =7930

$\alpha = 0.65$; $\beta = 0.95$; Density = 1.16

=7930/ 1.16 = 6836 m^3/ day

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Air requirement = 6836/ 24 = 284 m^3/ hr

Hence air flow rate is adequate.

SPECIFICATION OF SLUDGE HOLDING TANK

Adequacy Calculation

Size of the sludge holding Tank : 3.6 m x 3.5 m x 3.7 m (SWD)

Volume of the sludge holding Tank, V : 47 m^3

Flow Rate, Q : 13 m^3 / hr

Retention Time : 47/13

: 4 hours

Standard Retention hours for Sludge holding Tank is 3-5 hrs

Provided retention hours is = or > standard retention hours.

Hence it is adequate.

SPECIFICATION OF DECANT TANK

Adequacy Calculation

Size of the Decant Tank : 4 m x 8.5 m x 3.4 m (SWD)

No. of tank : 1

Volume of the Decant Tank, V : 116 m^3

Flow Rate, Q : 13m^3/ hr

Retention Time : 116/13

: 9 hours

Standard Retention hours for Decant Tank is 6-8 hrs

Provided retention hours is = or > standard retention hours.

Hence it is adequate

SPECIFICATION OF FINAL TREATED WATER TANK

Adequacy Calculation

Size of the Treated Water Tank : 4.0 m x 10.3 m x 3.7 m (SWD)

Volume of the Treated Water Tank, V : 152 m^3

Flow Rate, Q : 13 m^3 / hr

Retention Time : 152/13

: 12 hours

Hence it is adequate.



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SPECIFICATION OF UF TANK

Adequacy Calculation

Size of the UF Treated Water Tank : 5.6 m x 4.5 m x 3.7 m (SWD)

Volume of the UF Treated Water Tank, V : 93 m^3

Flow Rate, Q : 13 m^3 / hr

Retention Time : 93/13

: 7 hours

Hence it is adequate.

SPECIFICATION OF PRESSURE SAND FILTER

Adequacy Calculation

Flow rate Q : 13 m^3 / hr

Filtration rate for PSF (V) : 15 m^3 / m^2 hr

Q : A x V

A : 13/ 15

: 0.9 m^2

D^2 : 0.9 x 4 / 3.14

: 1.14

D : 1.0 m

Diameter provided is 1500 mm

Hence adequate

SPECIFICATION OF ACTIVATED CARBON FILTER

Adequacy Calculation

Flow rate Q : 13 m^3 / hr

Filtration rate for ACF (V) : 15 m^3 / m^2 hr

Q : A x V

A : 13 / 15

: 0.9 m^2

D^2 : 0.9 x 4 / 3.14

: 1.14

D : 1.0 m

Diameter provided is 1500 mm

Hence adequate



SPECIFICATION OF UV DISINFECTION SYSTEM

Adequacy Calculation

Voltage : 220-240 V / 50-60 Hz

Adequacy as per site conditions.

CONCLUSION AND RECOMMENDATIONS

Considering the following as the influent sewage load,

Suspended solids - 200 mg/L

BOD - 350 mg/L

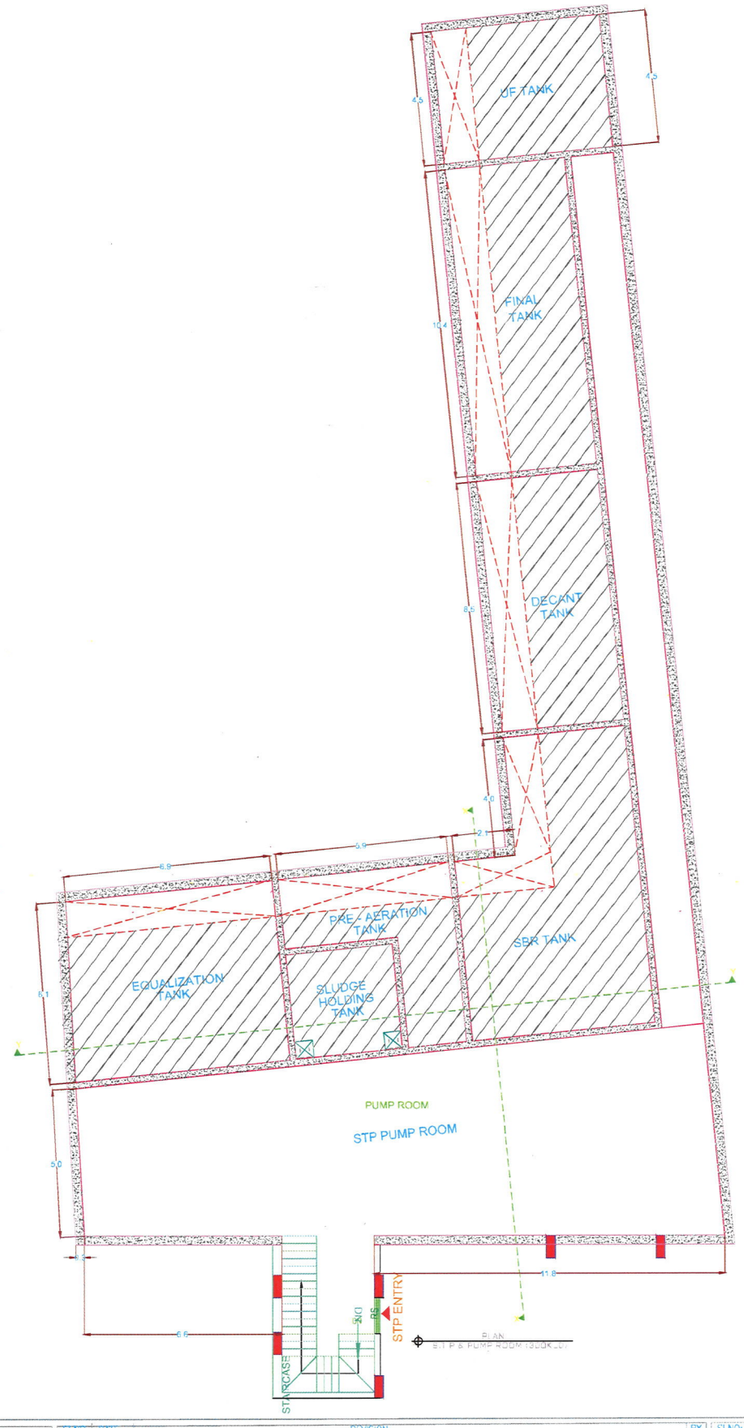
The final BOD of the treated wastewater from the proposed sewage treatment plant will be < 10 mg/l and the suspended solids concentration will be within below detectable limit based on the above evaluation.

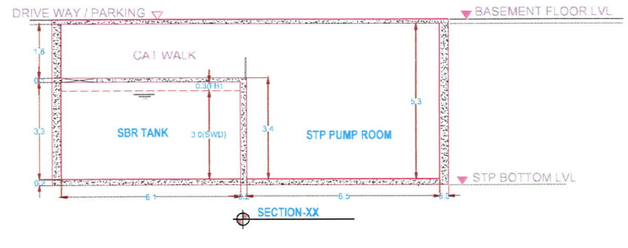
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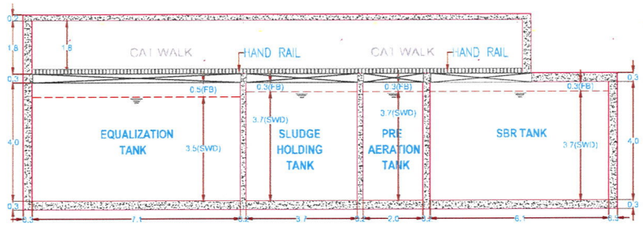
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**********End of report **********

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NO	DESCRIPTION	SIZE	CAPACITY 300KLD	QTY
01	EQUALISATION TANK	7.5MX6.1MX3.5M(SWD)	160 KLD	01
02	SLUDGE HOLDING TANK	3.6MX3.5MX3.7M(SWD)	46 KLD	01
03	PRE-AERATION TANK	21.2SQ.M X 3.7M(SWD)	78KLD	01
04	SBR	53.9SQ.MX3.4M(SWD)	183 KLD	01
05	DECANT TANK	4.0MX9.5MX3.4M(SWD)	115 KLD	01
06	FINAL TREATED WATER TANK	4.0MX10.3MX3.7M(SWD)	152 KLD	01
07	UF TANK	5.6MX4.5MX3.7M(SWD)	93KLD	01

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PROJECT:
PROPOSED APARTMENT COMPLEX
AT GOPARASANALLUR,CHENNAI.

DRAWING TITLE:
BASEMENT AND STILT FLOOR PLAN SHOWING STP TANKS AND PUMP ROOM LOCATION LAYOUT

DATE: 21.06.2023
SCALE: 1:125 @ A2
DRAWING NO: D&R/CA/PL 01B
REVISION NO: 02
DRAWN: A.VAISHNAVI
CHECKED: S.DURAI

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