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DESIGN OF SEWAGE TREATMENT PLANT OF 7.5 MLD CAPACITY BASED ON SEQUENTIAL BATCH REACTOR TECHNOLOGY AT DHANAS LOCATED IN CHANDIGARH

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Abstract - *Dhanas is a village Panchayat located in Chandigarh district in Chandigarh, India. The total geographical area of the village is about 5 km² making it the second biggest village by area in the sub district. Chandigarh administration constructed 8448 One Room Tenants (ORT) for Rehabilitation of Slums Dwellers in Dhanas, wherein it was proposed to build a state of art Sewage Treatment Plant to treat the sewage generated in the region to a water quality level where the treated sewage can be used as irrigation water and for artificial ground water recharge within the area or safely disposed off to nearby natural drain. An effort was made to self design the sewage treatment plant for the capacity of 7.5 MLD in which population, sampling and analysis, degree of treatment required, design of treatment unit and estimation of the cost will be under taken. The samples were tested to measure various parameters like BOD, COD, SS, FOG , Total P, Kejdhal N.*

Keywords:- Population, SBR(Sequential Batch Reactor), Design of Sewage treatment Plant, Estimation and Costing

1. INTRODUCTION

Fig -1: Location of Dhanas

Dhanas is a village Panchayat located in Chandigarh district in Chandigarh, India. The total geographical area of the village is about 5 km² making it the second biggest village by area in the sub district. Chandigarh administration constructed 8448 One Room Tenants (ORT) for Rehabilitation of Slums Dwellers in Dhanas. It is located 6 KM towards North from District head quarters Chandigarh. Dhanas is surrounded by S.A.S Nagar Tehsil towards South , Chandigarh Tehsil towards South , Kharar Tehsil towards west , Khera Tehsil towards west. It is in the border of two states. First State is Punjab State towards South and second state is Haryana State towards South.

Objective

- To study quality of waste water.
- To design all treatment units.
- To prepare design of sewage treatment plant with detailed cost estimation

2. POPULATION

The village is home to 7094 people, among them 4258 (60%) are male and 2836 (40%) are female according to the 2011 census. Currently the analysis of the population growth and expected development of Dhanas and an estimated population of about 0.5 lakh.

3. SITE

Fig -2: Location of Sewage Treatment Plant

4. TESTING OF SAMPLE

Table -1: Result of Sample

S.No	Parameter	Results
1.	COD (mg/l)	400
2.	BOD (mg/l)	200
3.	COD/BOD	2
4.	SS (mg/l)	200
5.	FOG (mg/l)	10
6.	Total P (mg/l)	8
7.	Kejhal (mg/l)	40

5. METHODOLGY

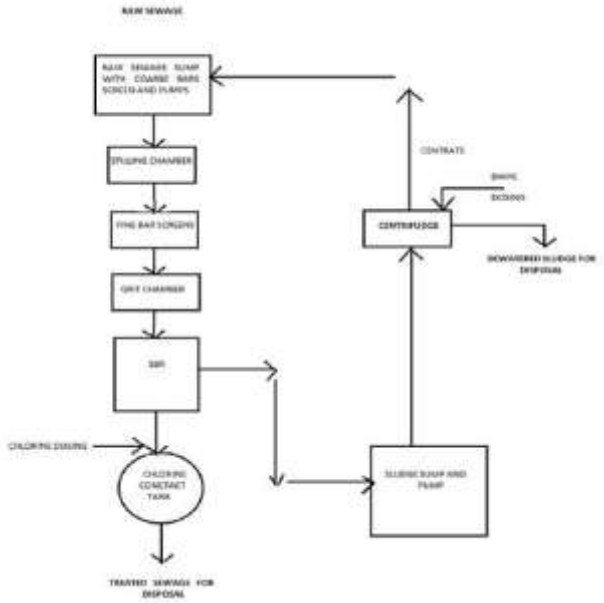

Fig -3: Flow diagram of treatment

RAW SEWAGE SUMP WITH COARSE BARS SCREEN AND PUMPS

Sewage shall enter into the wet wall of the raw sewage pumping station after screening. The wet well shall be circular in shape and shall be designed for an average flow of 7.5 MLD. The capacity of the wet well shall be kept such that the detention time in the wet well shall be minimum 10 minutes of peak flow and shall not exceed 30 minutes at average flow. Pump of the minimum duty/capacity shall run for atheist 5 minutes considering no flow. The capacity of the sump shall be kept that with any combination of inflow and pumping, the operating cycle for any pump shall not be less than 5 minutes. The side water depth (Live liquid Depth) shall be minimum 2m to 2.5m. The effective liquid volume shall be provided below the invert level of the coarse screen channels after leaving provision for a minimum of 0.3m.

STILLING CHAMBER

Stilling chamber shall receive raw sewage from the raw sewage pumping station. Stilling chamber shall be designed for average flow of 7.5 MLD with a peak factor of 2.25 .The design flow is 16.88 MLD. The detention period is 60 seconds for peak flow and the minimum free board is 0.5 meters

FINE BAR SCREENS

One Mechanical (Working) with one manual (Standby) screens shall be provided in the Fine Screen channels. Each fine screen channels shall be designed for 100% of peak flow. The clear opening for Mechanical screen shall be 6mm and be 10mm for Manual screen. The approach velocity at average flow show is 0.3m/sec. Velocity through screen at average flow (m/sec) is 0.6 of the maximum. Velocity through screen at peak flow (m/sec) is 1.2 maximum. The minimum freeboard is 0.5m. The manual screen flat bar thickness is 8mm and 50mm deep. The mechanical screen flat bar thickness is 2mm and 35mm deep.

GRIT REMOVAL UNIT

One mechanical and one manual Grit chamber of peak flow capacity shall be provided after fine screen channels. It should have one tapered Inlet channel running along one side with deflectors for entry of sewage in to the grit chamber. It should have one tapered outlet channel for collecting the de-gritted sewage which shall overflow over a weir in the outlet channel. It should also contain one sloping Grit classifying channel into which the collected grit shall be classified. The grit from the classifier shall be collected in a wheeled trolley. It should also consist of a grit scraping mechanism and adjustable influent deflectors.

SBR PROCESS WITH DIFFUSER AND AIRBLOWER

The complete system shall be designed for handling peak flow. Two basins/one basin with adequate volume shall be provided .In addition, 0.5m free board shall be provided to each basin. Maximum liquid depth shall be restricted to6m and each basin shall be 50% peak capacity. The system shall work on a continuous gravity influent condition. The system shall be designed for maximum F/M ration between 0.1-0.25kg BOD/kg MLSS day. MLSS maintained in the basin shall range from 2500 to 5000 mg/l. The cycle time of the SBR process shall be selected adequately with preferred cycle times containing maximum 50% not aerated portion. The effluent flow shall be continuous to the plant during all phases of operation.

The system will use a number of tanks operating in parallel in which the activated sludge is alternately aerated, mixed without aeration if appropriate, and allowed to settle over the course of pre-determined cycle. Solid liquid separation will occur during the settling phase of the cycle. After the settling phase, treated effluent will be decanted from the liquid surface.

The functions of flow equalization, biological oxidation, nitrification, de-nitrification, sedimentation and aerobic sludge stabilization will be all carried out in a single basin. Effluent removal (Decanting) will be by means of a mechanically driven decanter. Aeration will be by means of fine bubble diffused aeration using membrane diffusers.

SLUDGE SUMP AND PUMP HOUSE

Sludge sump shall be provided to collect the excess sludge from SBR process basins. The mixing blowers shall be positive displaced (roots) type and head for blowers shall be decided on the basis of maximum liquid depth in sump duly considering the losses governing point of delivery and he blowers. Blowers shall be complete with motor and accessories like Base frame, Anti Vibratory pads, silence, non Return Valve, Air filter etc as per requirements.

MECHANICAL DEWATERING UNITS

The dewatering system shall be so located that the dewatered sludge can be loaded into trolley/bins directly. Preferably the dewatering unit shall be so located that the dewatered sludge galls into the containers/Bins without requirement for another material handling unit. The dewatered sludge shall be truck able & be suitable for disposal by open body truck and shall have minimum solid concentration of 20% or more.

POLYELECTROLYTE DOSING

The polyelectrolyte shall be dosed online at the inlet of centrifuge sludge at 0.1% solution strength. There should be two polyelectrolyte dosing tanks suitable for minimum 8 hours of operation. Each tank should have slow speed mixer to prepare the solution. The pumps shall be interlocked with centrifuges so that it shall only be running when centrifuge is on and shall shut down when centrifuges stop.

CHLORINATION TANK

Treated sewage from SBR process basins shall be taken to chlorination tank by rcc channel/pipe. Baffle walls shall be provided to achieve proper disinfection. The detention time should be 30 minutes. Chlorination system comprising Chlorinators, water booster pumps, Interconnection piping, chlorine tonners/cylinder, weigh scale, Lifting device, safety equipments and other accessories shall be provided in the chlorination cum chlorine tonner house. The quantity of tonner shall be worked out on the basis of 3 ppm of chlorine dosing.

6. EXPECTED TREATED EFFLUENT QUALITY

Table -2: Treated Effluent

S.No	Parameter	Sample
1.	pH	6.5 to 7.5
2.	BOD (mg/l)	5 or less
3.	COD (mg/l)	100 or less
4.	Total suspended solids (mg/l)	10 or less
5.	Oil & grease (mg/l)	10 or less
6.	Ammonical Nitrogen (mg/l)	3 or less
7.	Dissolved Oxygen (mg/l)	2.0 or less

7. CONCLUSION

Considering the population growth, recently constructed 8448 One Room Tenants (ORT) for Rehabilitation of Slums Dwellers in Dhanas it was high time to install sewage treatment plant. The design of the sewage treatment plant is efficient, functional and easy to operate. The design of units is prepared on the basis of which detailed estimation has been worked out of the sewage treatment plant, which seems reasonable.

Table -3: Design of Units

S.No	Unit	Component	No.
1.	Raw Sump sewage with coarse Bars screen and Pumps	Pump:-175m^3/hr: W S	 3 1
2.	Stilling Chamber	Whole unit	1
3.	Fine Bar Screens	W S	1 1
4.	Grit Removal Unit	W(2mm and 35mm deep) S(8mm and 50mm deep)	1 1
5.	SBR Process	Decanting Device Aeration System SAS pumps:- per Basin Per standby	1 1 1 1
6.	Sludge sump and pump house	Whole unit	1
7.	Sludge Transfer and Mixing Blower	W S	1 1
8.	Mechanical Watering Units	W S	1 1

9.	Polyelectrolyte Dosing	Tanks	2
10.	Disinfection	Chlorination Tank Chlorination System : W S	1 1 1

Table -4: Estimation

S.No	Description of work	Quantity	Material Cost(INR)
1.	Receiving Chamber Integrated with coarse Bar Screen (a) For Mechanical (b) For Manual	 2 1	 8,00,000 60,000
2.	Fine Bar Screen (a) Clear Spacing- For Mechanical (b) Clear Spacing – For Manual	 1 1	 7,00,000 40,000
3.	SBR system (a)Air Blowers (b)Accoustic Encloser (c) Motors (d)Decanter (e)Basin	 3 3 3 1 2	 16,50,000 1,50,000 7,50,000 55,00,000 1,60,000
4.	Chlorination System	1	3,75,000
5.	Sludge Dewatering System (a) Centrifuge feed pump (b)Centrifuge	 2 2	 1,00,000 44,00,000
6.	Polyelectrolyte Dosing (a) Pumps with Motors (b)Tank aggregators with motor	 2 2	 1,60,000 1,40,000

*This cost excludes the concrete and reinforcement work
Total Cost=Rs. 14,985,000/-

(One Crore Forty Nine Lakhs Eighty Five Thousand only)

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