Planning And Analysis of Sewage Treatment Plant (43 MLD) in Sagar (M.P.)

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Abstract - *Wastewater treatment, also called sewage treatment, the removal of impurities from wastewater, or sewage or grey water, before they reach aquifers or natural bodies of water such as rivers, lakes, and oceans. During recent years, there has been an increasing awareness and concern about water conservation all over the world. Hence, new approaches towards achieving sustainable development of water resources have been developed internationally. Under this research paper, Network develops for sewer line in zonal pattern. The whole network of the city divided into three zones, and Sewage Treatment plant of 43 MLD have to develop. Treatment technology adopted is SBR technology. The results were very encouraging. The treatment system achieved 95.5% BOD, 90% COD, 75% Total Nitrogen, 95.67%TSS & 81.25% Phosphorus removal respectively.*

Key Words: Grey water, SBR, Sustainable development, BOD, COD, TSS, etc.

1. INTRODUCTION

Waste water treatment is an addition to the natural process of water purification. To maximize the use of natural resources, wastewater treatment plans are organized and implemented. Industrial wastewater treatment plants and sewage treatment plants are used to purify water and make it useful again. Due to industrial development, domestic effluent and urban run-off contribute the bulk of wastewater generated in sagar city. Domestic wastewater usually contains grey water (sullage), which is wastewater generated from washrooms, bathrooms, laundries, kitchens etc. It also contains black water made up of urine, excreta and flush water generated from toilets. Physical, chemical and biological processes are applied to remove physical, chemical and biological contaminants. Its objective is to produce a waste stream (or treated effluent) and a solid waste or sludge also suitable for discharge or reuse back into the environment [1].

In Sagar city, the common treatment technologies adopted for domestic and industrial sewage treatment are sequential batch reactors. According to Agency which are developing the sewage network, they are divided the hole city in three zones and have to plan three pumping station to collect the sewage from the city. The efficiency of sewage treatment plants can be illustrated by a study on the evaluation of pollutant levels of the influent and the effluent at the treatment plant of sewage treatment plants discharging into the environment .[1] The treatment plant at Sagar is designed to treat 43MLD sewage.

1.1 Present Scenario

Residents of the town producing both liquid and solid wastes. The liquid portion i.e. waste water essentially the water supply of the community after it has fould by a variety of uses. The waste water is being produced mainly from residences, institution, commercial and industrial establishment etc. In addition, this untreated waste water also contains toxic compound numerous pathogenic or disease causing organisms and nutrients which stimulating the growth of aquatic plants.[2] Apart of this the safety of structure such as buildings, roads will also been in danger. As the domestic sewage not being handled properly these are polluting the water source also.[3]

No doubt, Sagar is one of the leading township in Madhya Pradesh. It has peculiar position in M.P. for Dr. Harisingh Gour University, military establishment, police training college and Sagar Lake.

Presently this town is facing & felling all those nuisances and foul conditions. In other words the unsanitary conditions are not only creating pollution but also contaminating drinking water sources. The famous LAKHA BANJARA LAKE also being polluted. This lake was being used for domestic & generation of D.C. electric power, but now days the water of the lake is very much polluted. The present situation and public demand alarming for the proper underground sewerage system. Hence it is the urgent need of time to develop a mechanism in order to prevent lake water.

2. PLANNING

The main components of sewerage project are 254kms of pipelines, 9260 nos. of manholes, 10028 nos. of service chambers, 7780m length pumping main from pumping station to STP and a 43 MLD sewage treatment plant.

The sewerage mainly will comprise of following units:-

1. Collection and conveyance of sewage to treatment plant.
2. Treatment units.
3. Effluent and disposal and utilization.

2.1 Collection and conveyance of sewerage

Considering the contours, built up area of Sagar town, the total residential area has been demarked into three zones. For the purpose of sewer network, these three zones will be named as:-

1. Zone I
2. Zone II
3. Zone III

Zone I is the biggest zone in the planning, it consists 25 wards and proposed residential areas about 411.08 hectare. The estimate design population of the zone is 180858. Average sewage flow @ 108 lpcd is 19.53 MLD i.e. 226.07 lps without infiltration the peak flow as per design 555.21 lps at end of the zone i.e. at inlet to ps1. The sewer network consist of RCC and HDPE pipes. The total manholes in this zone are 4629.

Zone II has been designed to collect the sewage of 19 wards. The population to be covered in this zone is 165961 whose average flow @ 108 lpcd will be 17.92 MLD without infiltration. The peak flow as per design is 494.43 lps at the end of the zone i.e. at inlet of ps2. The total manhole of the zone is 2881.

Zone III is the smallest zone of the town, 9 wards are include in the zone. The population to be connected is 82167. The average flow at the end of the zone @108lpcd is 8.87 MLD. The total nos. of manholes is 1670 in this zone.

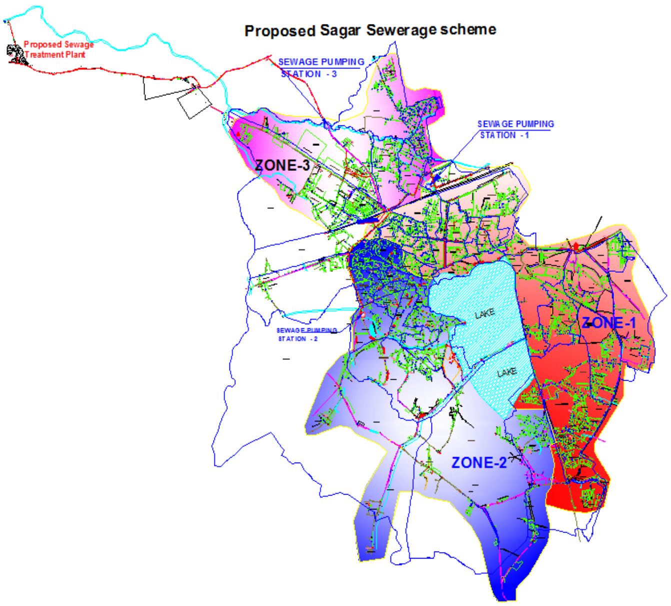

Fig -1: Proposed Sagar Sewerage Scheme

2.1.1 Pumping station and pumping of sewage

In the sewerage system at following locations the sewage cannot under gravitational forces and thus it requires its lifting. The details of the locations are:-

(i). PS-1 – In zone I the pumping station no. 1 will be constructed at a point just nearby railway bridge existing adjacent to railway crossing near Apsara Talkies. This point will be denominated as PS-1. The estimate cost of PS1 is 22.12 lacs.

(ii). PS-2 - The PS2 is located near Sheetla Mata Mandir in zone II. The estimate cost of this is 20.63 lacs.

(iii). PS-3 – A pumping station has been proposed along pagara road where sewage of PS1 and PS2 will be collected & from this pumping station the sewage will be pumped to S.T.P. proposed at Village Pathariya Hat. The estimated cost of PS 3 is 40.33 lacs.

Table -1: Details of pumping station

Sr. No.	Pumping Station	Peak flow in lps	Capacity of PS for peak flow in cum
1	PS 1	555.21	124.92
2	PS 2	494.39	111.25
3	PS 3	1297.66	291.97

Table–2: The estimated cost of pumps and generator

Sr. No.	Pumping Station	Cost of pump (lacs)	Cost of generator (lacs)
1	PS 1	189	90
2	PS 2	122	66
3	PS 3	495	318
	TOTAL	**806**	**312**

2.1.2 Pumping Main

Sewage from pumping station, will be pumped to a point near Railway Gate Khurai road and from this point it will flow by gravity up to PS 3. The pumping main from PS1 to junction is 1130 m. long of 500mm dia DI pipe. The pumping main from PS2 to railway gate is 1350m. of 500mm dia. pipe. Similarly sewage from PS3 will be required to pump up to STP. This pipe line will be 800mm dia DI pipe 5300m. long. For the above pumping main the estimated amount is 1519 lacs.

2.2 Treatment Units

A. Primary Treatment System

i. Inlet Chamber
ii. Fine Screens
iii. Grit Removal Unit
iv. Oil And Grease Removal Chamber
v. Parshall Flume

B. Sequential Batch Reactor

C. Chlorination System

D. Sludge Handling

i. Sludge Sump And Sludge Transfer Pump
ii. Mechanical Dewatering Unit
iii. Centrate Sump And Pump

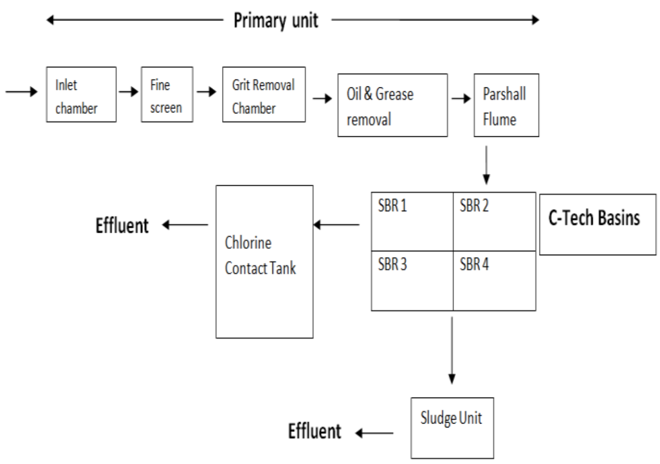

Fig. 2:- Flow Diagram of Treatment Plant

A. Primary Units:

Inlet chamber:

Inlet chamber is provided at higher ground level to receive raw sewage from Raw sewage pumps through discharge pipelines. The purpose of providing inlet chamber is to reduce the velocity of sewage coming via pumping so as to achieve better efficiency in screening.

Design flow: 97.50 MLD
Number of units: 1 No.
Material of construction: RCC

Fine screen channels:

Raw sewage from the inlet Chamber flows by gravity into the fine screen channels. There are two numbers of parallel fine screen channels are provided, one for mechanical screen and another for manual screen. Sluice gates are provided are provided on upstream & downstream of screen channels to regulate the flow and to isolate them for maintenance.

Mechanical fine Screen

Design flow: 97.50 MLD
No. Of unit: 1 No.
Material of construction: SS304 wetted parts

Manual Fine Screen

Design Flow : 97.5 MLD
No. Of units: 1no.
Material of construction: SS304 wetted parts

Grit Removal Unit

The screened Sewage flows by gravity into Grit Removal unit. There are two nos. of parallel grit removal units are provided. One is mechanical and one is manual grit chamber. The grit is settled in the main chamber & after de gritting the sewage overflow into the outlet channel. Sluice gate is provided at the inlet of grit chamber.

Mechanical grit chamber :

Design flow: 97.50 MLD
No. Of unit: 1 No.
Material of construction: RCC

Manual grit chamber :

Design flow: 97.50 MLD
No. Of unit: 1 No.
Material of construction: RCC

Oil and Grease removal channel

De-gritted sewage flows by gravity into the oil and grease removal chamber. Provision for underflow and overflow baffle arrangement is considered with perforated pipe at the top to collect accumulated Oil & Grease.

No. Of unit: 1 No.
Material of construction: RCC

Parshall flume

Screened and de-gritted sewage from Oil & grease chamber flow through Parshall Flume. The Parshall Flume channel shall be equipped with ultrasonic flow meter for measuring the flow.

Design flow: 97.50 MLD
No. Of unit: 1 No.
Design: As per CPHEEO standards
Material of construction: RCC

B. C-tech Basins (SBR)

There are 4 operating C-tech basins in the plant. These C-tech basins work in sequence and the influent flow is distributed using automatic Gates provided at the inlet Chamber of C-tech basins. The C-tech basins are equipped with air blowers, diffusers, Return Activated Sludge(RAS) pumps, Surplus Activated Sludge (SAS) pumps, Decanters, Auto valves, Programmable Logic controller (PLC) etc. All the cycles will be automatically controlled using PLC.

Excess sludge at a consistency level of approx 0.8% to 1% will be formed intermittently from SAS pump to the sludge sump. The sludge from sludge sump is taken for dewatering and finally for its ultimate disposal. The treated effluent from c-tech basins will then passed through chlorination tank where it is this infected before its ultimate discharge.

C. Chlorine Contact Tank

The Effluent from the SBR basins will be collected in Chlorine Contact Tank .The supernatant thus collected will get disinfected in Chlorine Contact Tank by adding suitable dose of chlorine and finally it is discharged.

Chlorination system

Design flow: Avg. Flow
No. Of Chlorinators: 2 No.(1W+1SB)

Chlorine Contact Tank

Design flow: Avg. Flow
No. Of unit: 1 No.
Material of construction: RCC

D. Sludge Handling

The sludge as collected from SBR basins is collected into sludge sump and conveyed to Centrifuge unit for dewatering the same. The necessary centrifuge feed pumps & Centrifuges will be provided. A chlorination house is provided to house the chlorination system comprising vacuum chlorinators, water booster pumps, interconnecting piping & valves, chlorine tonners, roller supports, lifting device, safety equipment and other accessories.

Sludge sump:

Design flow: Sludge generated from SBR
No. Of unit: 1 No.
Material of construction: RCC

Sludge pumps:

Design flow: Progressive Cavity Pump
Material of construction: Body: CI , Wetted parts: SS304
No. Of unit: RCC

Sludge sump Air blower

Type: Positive Displacement Type
No. Of Units: 2 no. (1W+1SB)

Mechanical watering device

Sludge dewatering unit:

Type: Solid bowl Centrifuge
No. Of Units: 3 no. (2W+1SB)

Polymer dosing Tank

No. Of Units: 2 no. (2W+1SB)
Material of construction: RCC

Polymer dosing tank agitator

No. Of Units: 1 no.
Material of construction: SS304

Centrate sump and pump

Centrate sump

No. Of Units: 1 no.
Material of construction: SS304
Detention period: 1hr.

Centrate Transfer pump:

Type: Submersible pump
No. Of unit: 2 No.(1W+1SB)
Material of construction: : CI , Wetted parts: SS304

Design Period:-

As per the recommendation of the CPHEEO manual on sewage and sewerage treatment system issued in Nov. 13, the design period from base year, for different units are describe in table no. 3.

Table no. 3

1	Sewer network	30 yr.
2	Pumping main	30 yr.
3	Pumping machinery	15 yr.
4	Sewage treatment plant	15 yr.
5	Pumping station	30 yr.
6	Effluent disposal	30 yr.
7	Effluent utilization	15 yr.
8	Project implementation period	4 yr.

4. Analysis

3.1 Why 'SBR'

The activated sludge process has been used extensively. During the operation of an activated sludge plant F/M ratio should be maintained properly, which is achieved by increasing or decreasing the MLSS levels in bulking is due to inadequate air supply. In activated sludge process high quality of effluent is produced at reasonable cost. A clear and odourless effluent is obtained from activated sludge treatment process. Carefully handled and well maintained plants produce 95% body 95% SS and 90% bacteria. Plant requires less space and very little heat. There is no fly nuisance as in the case of trickling filters. It as high operational cost and constant Vigilance is necessary. It produces large quantity of Sludge.

The trickling filter at normal rate of loading removes 70 to 90% BOD, 80 to 90% bacteria and 90 to 92% solid matter. The filter is subject to nuisance caused by flies, high cost of construction. The trickling filter requires large mass of filtering material, which requires very large area. For final settlement humus tank is necessary. Ponding or clogging of filter media in trickling filter is one of the most important operational problems.

The oxidation Ponds has the limitations of requiring large areas of land. There is mosquito's nuisance in the oxidation Ponds. The sludge is very small BOD removed in oxidation pond is 73 to 95%. No skilled workers are required for operation and maintenance of oxidation pond. But large area is required for construction, which is nearly 90 hectare in this case. If normal working is unsettled, it creates sight and foul smell nuisance.

The trickling filter requires more area than activated sludge process. Area, which is needed for trickling filter, is about 210 m^2/ 1000 persons whereas for activated sludge process it is 35m2/1000 persons.

As briefed above SBR technology is better than all the technologies. Therefore, in view of about the SBR technologies proposed to be adopted for the treatment of sewage. The capacity of STP is 43 MLD for which and amount of rupees 3870 lacs has been proposed @ of ₹ 90 lacs/MLD.

3.2 Design Parameters

- **At Inlet**

Sr.no.	Parameter	Unit	Design Value
1	Suspended solid	mg/l	231
2	BOD	mg/l	224
3	COD	mg/l	500
4	Total Nitrogen	mg/l	40
5	Free Ammonia	mg/l	25
6	Total Phosphorus	mg/l	8

- **At Outlet**

Sr. no.	Parameter	Unit	Design Value
1	pH		6.5-9
2	BOD	mg/l	≤10
3	COD	mg/l	≤50
4	Suspended solid	mg/l	≤10
5	Total Nitrogen	mg/l	≤10
6	Total Phosphorus	mg/l	≤2

5. CONCLUSIONS

SBR technology is economical efficient, safe and future ready than other sewage technologies. The SBR technology gave the highest values of percentage removal for COD, total phosphate, ammonia, nitrogen and ortho phosphate proving to be better technology than others.

SBR process advantages are single tank configuration, easily expandable, simple operation and low capital costs. Improvements in aeration devices and controls have allowed SBRs to successfully compete with conventional activated sludge systems. A U.S.EPA report summarized this by stating that, "The SBR is no more than an activated sludge system which operates in time rather than in space."

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