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A Research Paper on Design of Sewage Treatment Plant for Bhandara City

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Abstract: *Bhandara Municipallity has been upgraded with corporation status. The steady incremental in the city population result in the increase of domestic sewage generation. But still now there is no treatment plant. So it is required to construct a sewage treatment plant with sufficient capacity to treat the increased sewage. The project deals with the design of sewage treatment plant and its major components such Screening chamber, Grit chamber, Skimming tank, Sedimentation tank, Secondary clarifier, Active sludge tank and Sludge drying beds. The project covers the 10.54 sq. km, 48 wards of Bhandara Municipal Corporation for next 30 years and its increased population. Bhandara city, the Head Quarters of the Bhandara District is at a distance of 40 km East of Nagpur and 95.2 km North of Chandrapur. With regard to Bhandara, almost the entire town and environment are plain and the general slopes from West to East. The town is situated at the altitude of 21.17^0 N latitude and 79.82^0 E longitude. The soil of the area is being gravel, rocky and a large proportion of sand and gravel. All the aspects of Bhandara's climate topography, its population growth rate is to be considered while designing the project. By the execution of the project the entire sewage of the city can be treated effectively and efficiently.*

Keywords :- *Sewage, Skimming tank, Sludge drying bed, Sedimentation tank.*

I. Introduction

Sewage Treatment is the process of removing contaminants from waste water and household sewage, both runoff (effluents) and domestic. It includes physical, chemical and biological processes to remove physical, chemical and biological contaminants. Its objective is to produce a treated effluent and a solid waste or sludge suitable for discharge or reuse back into the environment. This material is often inadventently contaminated with many toxic organic and inorganic compounds.

Sewage implies the collecting of waste waters from occupied areas and conveying them to some point of disposal. The liquid wastes will require treatment before they are discharged onto the water body or otherwise disposed of without endangering the public health or causing offensive conditions.

As the cities have growth, the more primitive method of excreta disposal have gain place to the water – carried sewerage system. Even in the small cities the greater safety of sewerage, its convenience and freedom from nuisance have caused it to be adopted wherever finances permit.

II. Treatment Of Sewage

The treatment of sewage consist of many complex functions. The degree of treatment depends upon the characteristics of the raw inlet sewage as well as the required effluent characteristics.

Treatment processes are often classified as :-

1) Preliminary treatment
2) Primary treatment
3) Secondary treatment
4) Tertiary treatment

1) Preliminary treatment

Preliminary treatment consist solely in separating the floating materials like tree Branches, Papers, Pieces of rags, Wood etc. and heavy settalable inorganic solids. It helps in removal of aids and grease and reduces the BOD by 15% to 30%. The processes under this are:-

- Screening – To remove floating papers, Rags, Clothes.
- Grit chamber – To remove grit and sand.
- Skimming tank – To remove oils and greases.

2) Primary treatment

Primary treatment consist in removing large suspended organic solids. It is usually accomplished by sedimentation in setting basins. The liquid effluent from the primary treatment often contains a large amount of suspended organic material and has a high BOD (about 60% of original).

3) Secondary treatment

Here the effluent from primary treatment is treated through biological decomposition of organic matter carried out either aerobic or anaerobic conditions.

Aerobic Biological Units

- Filters (Intermittent sand filters, Trickling filters).
- Activated sludge plant (Feed of active sludge, Secondary settling tank and Aeration tank).
- Oxidation ponds and Aerated lagoons.

Anaerobic Biological Units

- Anaerobic lagoons.
- Septic tanks.
- Imhoff tanks.

The effluent from the secondary treatment contains a little BOD (5% to 10% of original) and may contain several milligrams per litre of DO.

4) Tertiary treatment

The purpose of tertiary treatment is to provide a final treatment stage to raise the effluent quality before it is discharged to the receiving environment (Sea, River, Lake, Ground, etc.). More than one tertiary treatment process may be used at any treatment plant. If disinfection is practiced, it is always the final process. It is also known as "Effluent Polishing".

III. Object Of Treatment

The main of treatment is to reduce the sewage contents (solids) from the sewage and remove all the nuisance causing and changes the character of the sewage in such a way that it can be safely discharged in natural water course applied on the land.

In other words, the objective of sewage treatment is to produce a disposable effluent without causing harm or trouble to the communities and prevent pollution.

Practically the treatment of sewage is required in big cities only where the volume of the sewage is more as we all quantity of various types of solid industrial sewage etc. Is more and porous land or large quantity of water bodies is not available for the proper disposal of sewage.

IV. Degree Of Treatment

The degree of treatment will mostly be decided by regulatory agencies in the extent to which the final product of treatment are to be utilized the regulatory bodies might have laid down standard for the effluent or might specify the condition under which the effluent must be discharged into the natural stream. The method of treatment adopted should not only meet the requirement of the regularly bodies but also result in the maximum use of the end products with economy.

Design Period

The treatment plant is normally designed to meet the requirement over a 30 years period after is completion the time lag between the design and completion should not normally exceed 2-3 years card should be taken that the plant is not considerably under loaded in the initial stages. Particularly the sedimentation tank.

The ultimate design should be 30 years and to that extent sufficient accommodation should be provided for all the units necessary to cuter to the need of ultimate population. In some cases it may be necessary to combine a number of sewage system with a common sewage treatment plant.

Parameters	Raw sewage Bhandara corpo.	Effluent (Expected)
P^H	6^4	5.5-9.0
BOD	300 mg/lit	≤ 20 mg/lit
COD	600 mg/lit	≤ 250 mg/lit
Oil and Grease	50 mg/lit	≤ 5 mg/lit
Total suspended solids	600 mg/lit	≤ 30 mg/lit
Ammonia nitrogen	50 mg/lit	≤ 50 mg/lit
Total phosphorus	5 mg/lit	≤ 5 mg/lit
As DO^4	5 mg/lit	≤ 5 mg/lit
Total coil form	100000 MPN/md	≤ 1000 no/md
Nitrogen	61 mg/lit	≤ 5mg/lit

- Raw sewage effluent characteristics tested in environmental laboratory with technical division Bhandara Corporation.
- Expected effluent characteristics according the design.

Sewage Desposal

The dispose of treated effluent into land of water body is sewage disposal. This can be of two method :-

1) Dilution – Disposal in water bodies.
2) Effluent irrigation – Disposal on land.

1) Dilution :-

The disposal of effluent by discharging it into water courses such as streams, Rivers or Large body of water such as Lake, Sea is called dilution.

2) Effluent irrigation :-

When the effluent is evenly spread on the surface of land it is effluent irrigation. The water of sewage percolates on the ground and the suspended solids remain at the surface of the ground. The remaining organic suspended solids aver partly acted upon by the bacteria and are partly oxidized by exposure to atmospheric actions of heat light and air.

While considering the characteristics of Bhandara Corporation it is referred that effluent irrigation i.e. Disposal for the following reasons :-

i. Bhandara Corporation is not a costal city i.e. sea is not oat of reach.
ii. Bhandara does not have any perennial river makes impossible for dilution.
iii. The near by river steam paller has very small amount of dry weather flow. In summer season it runs dry.
iv. The sewage treatment plant is designed according to Indian standards which produce effluent having lesser hazardous characteristics than the standards of land disposing.
v. It is an alternative source of water for irrigation and it contain the manual and some amount of NPK compounds.

Sr. no.	Characteristics	Tolerance limit as per IS:3307-1986	Effluent from the plant
1	P^H	5.5-9.0	5.5-9.0
2	BOD	100 mg/lit	≤ 20 mg/lit
3	Suspended solids	200 mg/lit	≤ 30 mg/lit
4	Oil and grease	10 mg/lit	≤ 5 mg/lit
5	Chlorides	600 mg/lit	≤ 400 mg/lit
6	Sulphate	1000 mg/lit	≤ 250 mg/lit

Silent Details Of Project

Sr. no.	Attibute	Data
1.	Project	Sewage treatment plant for Bhandara Municipal Corporation.
2.	Sewage type	Partially separate sewerage system
3.	Population census 1961 27710 1971 39423 1981 56025 1991 71813 2001 85213	
4.	Method of fore casting	Incremental increase method
5.	Design population Base year – 2021 Intermediate – 2031 Ultimate - 2041	 110796 133033 163000
6.	Per capita water supply	135 lpcd
7.	Existing sewerage system	Nil

V. Conclusion

A successful technical project involves integration of various fields. This is an attempt to combine several aspects of environmental, biological and chemical and civil engineering.

Since, in Bhandara Municipal Corporation there is no proper treatment plant for sewage, it is necessary to construct a sewage treatment plant. The plant is designed perfectly to meet the future expansion for the next 30 year in accordance with Indian Codal Provisions. This project consist the design of the complete components of a Sewage Treatment Plant from Receiving chamber, Grit chamber, Skimming tank, Sedimentation tank, Secondary clarifier, Active sludge tank and Sludge drying beds for sewage.

Plant Details

Components	Type	Nos.	Dimensions
Wet well		1	14.8 m × 8.75 m (Circular)
Pump	Centrifugal	4	45 BHP
Bar screen	1 manual, 1 mechanical	2	1.0 m × 0.7 m (SWD)
Grit chamber	Disc type, Mechanical	1	15 m × 0.7 m × 1.20 m
Sedimentation tank	Air diffuser + Chlorine gas	1	36 m × 13.60 m × 3.5 m
Primary clarifier	Circular type, Rad -ial flow	1	29.9 m × ø 2.5 m (SWD) + 0.5 m (FB)
Aeration tank	Combine Doroco type	1	54 m × 10 m × 4.5 m + 0.5 m (FB)
Secondary clarifier	Circular type, Radial flow	1	37 m ø × 3.5 m (SWD)+ 0.5 m
Sludge drying bed	Sand + Graded graveled	5	12.5 m × 8 m

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