Design of Wastewater Treatment Plant Based on Assessment of Contamination for Kapil Village

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Abstract -The rising urbanization and industrialization have created huge amounts of wastewater, which posses significant risks to public health and the environment. Wastewater contains pollutants such as organic compounds, pathogens, nutrients, heavy metals, and microplastics, and if not treated, may pollute natural water bodies. A wastewater treatment plant becomes essential to counteract such effects by reducing harmful substances efficiently and facilitating the safe discharge or reuse of treated water. This Study underlines the importance of a Wastewater treatment plant in analyzing the physical , chemical factors of untreated wastewater. It also divide into the processes of primary, secondary, and tertiary processes, and the innovative technologies such as the use of membrane bioreactors and the process of anaerobic digestion. Additionally, the Study underlines the need to follow proper drainage system according to the slope of selected area that can be reduced the un wanted expenditure . A Wastewater treatment plant not just saves ecosystems but also conserves water and reuse the treated water and use the remaining slide as fertilizer to fertile the agricultural land.

Key Words: Wastewater treatment plant, TDS, BOD, Public Health.

1.INTRODUCTION:

Water pollution due to untreated domestic sewage is one of the most pressing environmental challenges in India, particularly in rural regions where infrastructure for wastewater management is often inadequate or absent. Villages located near rivers are especially vulnerable, as unregulated discharge of sewage leads to severe degradation of water quality, adversely impacting both human and ecological health.

This Study focuses on the planning and design of a 3 million liters per day (3 MLD) capacity Sewage Treatment Plant (STP) for Kapil village, situated in the Maharashtra state of India. Kapil, with a population of approximately 7500 people, generates an estimated 3.0 MLD of wastewater, assuming a per capita water supply of 120 liters per day and 80% wastewater generation. At present, the sewage is discharged untreated into the nearby Krishna River, contributing to river pollution, deteriorating groundwater quality, and public health risks. This paper aims to provide a comprehensive model for developing decentralized wastewater treatment infrastructure in rural India, contributing to environmental protection, public health improvement, and sustainable water management. The findings and methodology are intended to serve as a reference for similar rural development initiatives across the country.

2.OBJECTIVES:

The objectives of this study are followings:

1) Literature review related assessment of wastewater for design of treatment plant .

2)Collect data, maps, Population,etc. regarding wastewater from study.

3) Carry out test on wastewater for analysis purpose.

4)Design wastewater treatment plant and prepare corresponding model.

3.SAMPLE COLLECTION AND TEST CARRIED OUT :

3.1 Sample Collection:

While undertaking field investigation of the planned sewage treatment plant in Kapil village, Maharashtra, a methodical and organized approach was followed for

collection of wastewater samples to accurately determine sewage characteristics.

Photo No 3.1

3.2 Test Carried Out:

For analysis and design purpose following tests are carried out:

3.2.1 PH

The Fresh sewage is generally Alkaline in nature. i.e. The pH of water is always greater than 7. But as the time passes the pH tends to falls due to production of Acids by the decomposition of organic matter and hence the sewage becomes 'Acidic' in nature. So old or Past Sewage is always found to be 'Acidic in nature.

3.2.2 COD

Chemical oxygen demand measures the amount of oxygen required for oxidation of organic compounds present in water by means of chemical reactions involving oxidizing substances such as K2Cr2O7 and KMnO4. K2Cr2O7 is the most suitable oxidant but for waters having more than 2 g/L of chlorides, KMnO4 is used, though the results are more variable because KMnO4 is self oxidizing.The estimation of COD is of great importance for waters having unfavourable conditions for the growth of microorganisms.

3.2.3BOD

Bio-chemical oxygen demand is defined as the amount of oxygen required by micro-organisms to stabilize biologically decomposable organic matter in a waste under aerobic condition.

It is an approximate measure of the amount of biochemically degradable organic matter present in the sample.More the oxidizable organic matter present in water, more the amount of O_2 required to degrade it biologically, hence more the bio-chemical oxygen demand. The bio-chemical oxygen demand test is generally performed to determine.

1. The degree of pollution in lakes and streams at any time.
2. The pollution load of waste waters.
3. Efficiency of waste treatment plants

Bio-chemical oxygen demand is evaluated by measuring oxygen concentration in sample, Idometrically before and after incubation in the dark at 20 °C for 5 days. Preliminary dilution and aeration of sample (with the help of dilution water) are necessary to ensure that not all the O_2 is consumed during incubation. Excess dissolved O_2 must be present during the whole incubation. Samples absorbing more than 6 mg/L of O2 should therefore be
diluted with a synthetic dilution water made from bio-chemical oxygen demand free distilled water to which the major constituents are added in the same concentration as in the sample. Sometimes a culture bacteria (seed material) is added so that more of the organic matter will be used up during incubation.

3.2.4 TDSSalts like CO_3, HCO, CI, SO_4, HPO_4 & NOs of Ca, Mg, Na, K, Fe and Mn etc are dissolved in natural waters.The high content of dissolved solids increases the density of water and influences osmoregulation of fresh water organisms. They reduce solubility of gases (like O_2) and utility of water for drinking, irrigational and industrial purposes.

3.2.5 Nitrates IF Nitrate is present in water it indicates the past or old pollution of the river or. Stream.

Nitrate is determine by using Colour matching Technique.

Nitrate indicates that the organic matter is Completely oxidized This concentration, does not affects the adults but can pirove to be, harmful for new born babies which causes, the disease like 'Blue Baby Disease or also called as 'Methamoglobenemia.

Photo No 3.2

4.RESULTS AND DISCUSSION:

Following are the results of tests conducted:

Table No.4.1.Test Results

Sr. No.	Parameters	Results	Permissible Limit (CPCB)
1.	pH	6.0	6.5-8.5
2.	Biochemical Oxygen Demand (BOD5)	189 mg/L	< 30 mg/L
3.	Chemical Oxygen Demand (COD)	280 mg/L	< 250 mg/L
4.	Total Suspended Solids (TSS)	260 mg/L	< 100 mg/L
5.	Total Dissolved Solids (TDS)	650 mg/L	< 2100 mg/L
6.	Nitrates (NO3)	12 mg/L	< 10 mg/L
7.	Phosphates (PO43-)	6 mg/L	< 5 mg/L
8.	Chlorides	344 mg/L	< 250 mg/L

4.2. Design Components Of Treatment Plant:

Table No.4.2. Design Components Of Treatment Plant

Sr.No.	Component	Size	No
1.	Screening	1.6×0.53m	2
2.	Grit Chamber	12×3×1.05m	1
3.	Sedimentation Tank	36×2×6m	1
4.	Clarifier	Dia-11m Depth-5.5m	1
6.	Aeration Tank	7.56×20×5m	1
7.	Sludge Digestion Tank	Depth-6m Dia-6m	1

4. CONCLUSIONS :

1) Wastewater generation has become a critical issue as urbanization and industrialization continue to rise rapidly. Discharge of untreated Wastewater posses a serious issue to public health, aquatic life & environment. However concerned agencies are not paying the much attention to control the wastewater discharge. Due to rapid population growth wastewater generation issue also increases.

Consequently, if right attention is not paid to the problem of generation of wastewater, the Continuous urbanization will complicate the incurable wastewater problem.

According to the study of literature review many scientists are working on reducing the Contaminants present in wastewater and reuse the treated water for various purposes.

2) At Kapil also the same scenario is observed village generated huge amount of wastewater .But this generated waste water directly discharged into the Krishna river. Not only the Kapil village directly discharge the wastewater into the Krishna river but also other 11 villages directly discharged wastewater into the river. Around 2 lakh litres of wastewater directly discharged into the river daily. The Krishna river is receiving a large quantity of contaminated water from these villages.

3) Due to discharge of wastewater directly into the river it causes algal growth, increase nitrate content ,ammonia content this content increases the required treatment processes on wastewater , it affects as increase the cost of potable water plant.

4) For reducing the pollution of Water & Increase the quality of water. This project analysed that Design Wastewater treatment plant for Kapil Village. According to the collected data for 3 MLD capacity of Wastewater treatment plant. With the providing following treatment processes based on samle test results:-

Screening Grit Chamber sedimentation Tank Clarifier Aeration Sludge Digestion Tank

5) By products of the treatment process that is sludge. Sludge is the solid waste that remains after treatment.sludge used as a fertilizer for agricultural

purpose, gardening purpose .It has high fertility. Also local authorities can earn profit from by selling sludge.

6) It is finally concluded that as suggested sewage treatment process for kapil village for reduce contamination in river, same treatment process need to be adopted by each and every village and city located on bank of Krishna river as well as all rivers.

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