STUDY ON DESIGN SEWAGE TREATMENT PLANT

SHRIYANSH SONI[1] , ANKIT PRATAP RATHOR[2] , SUDHAR SINGH RAJPUT[3] , SAURAB CHAND[4] , PUSHPRAJ SINGRAUL[5]

[1]STUDENT, CIVIL ENGINEERING, OIST , BHOPAL M.P. INDIA

[2]STUDENT, CIVIL ENGINEERING, OIST , BHOPAL M.P. INDIA

[3]STUDENT, CIVIL ENGINEERING, OIST , BHOPAL M.P. INDIA

[4]STUDENT, CIVIL ENGINEERING, OIST , BHOPAL M.P. INDIA

[5]STUDENT, CIVIL ENGINEERING, OIST , BHOPAL M.P. INDIA

ABSTRACT

The dirty water that comes from homes and businesses as a result of laundry, using the bathroom, and all the soapy water that comes from wasting dishes and the likes in the kitchen is what we call sewage or wastewater. Rainwater entering drains and industrial wastes also appear to fit under this category. Sewage is treated by a variety of methods to make it suitable for its intended use, be it for spraying onto irrigation fields (for watering crops) or be it for human consumption. Sewage treatment mainly takes place in two main stages: Primary and Secondary treatment. In arid areas, where there is not enough water, sewage also undergoes a tertiary treatment to meet the demands of the drinking water supply. During primary treatment, the suspended solids are separated from the water and the BOD (Biochemical Oxygen Demand) of the water is reduced, preparing it for the next stage in wastewater treatment. Secondary treatment can he accomplished by a wide variety of means. However, in our project and poster, we will only be concentrating on two of the most commonly used methods: the trickling filter and activated sludge. The activated sludge method uses air and a biological floc that is comprised of bacteria (mainly Zoogloca) and protozoans. This "aeration" continues for 4-6 hours, after which it is stopped and the contents moved to a settling tank. In the settling tank, the floe settles out and removes much of the organic material with it. This process removes 75-95% of the BOD. In the trickling filter, sewage is passed (as a fine spray) over a bed of rocks or molded plastic, over which a biofilm of aerobic microorganisms grow. This method removes 80 to 85%% Of BOD. The water is then disinfected, mostly by chlorination, and released into flowing streams or oceans. If needed (or desired), the sewage water can be treated in such a way as to make it safe for consumption. This is where tertiary treatment appears. The sole purpose of any tertiary treatment is to make sewage water (after it has passed through secondary treatment) suitable for human consumption, in other words, it gives us potable water. It removes phosphorus, nitrogen, and the remaining BOD by liming, subsequent nitrification and denitrification, and using filters of fine sand or activated charcoal, respectively. The poster will cover topics ranging from a brief history of the various stages in treating. sewage to details of the various steps in sewage treatment. The model will aim to explain the stages of the wastewater treatment with alternate group members elaborating

each step as the explanation proceeds. Explanations may include a brief summary of wastewater treatments in western countries and in their eastern counterparts. In short, the model, together with the poster, will aid the general public in understanding where their wastewater goes and how it is dealt with.

1. INTRODUCTION

A sewage treatment plant (STP), also known as a wastewater treatment plant, is a facility designed to remove contaminants from wastewater, primarily from domestic and industrial sources, before releasing it back into the environment or reusing it.
Here's a more detailed introduction:
Purpose: The primary goal of an STP is to purify wastewater, removing pollutants, pathogens, and other harmful substances to protect public health and the environment.
Wastewater Sources: STPs treat wastewater from various sources, including homes, businesses, industries, and public facilities.
Treatment Processes: STPs employ a combination of physical, chemical, and biological processes to treat sewage, including:
Preliminary Treatment: Removing large debris and grit.
Primary Treatment: Separating solids from liquids through sedimentation. Secondary Treatment: Using biological processes to remove organic matter. Tertiary Treatment: Further polishing the water for specific reuse purposes, like irrigation or groundwater recharge.

Byproducts: STPs also manage the byproducts of sewage treatment, such as sludge, which can be treated and disposed of or used as fertilizer.

Importance: STPs play a vital role in maintaining water quality, protecting public health, and ensuring the sustainability of our water resources.

Centralized vs. Decentralized Systems: Sewage treatment can be done at centralized municipal plants or decentralized on-site systems like septic tanks.

Evolution: The development of centralized sewage treatment plants has significantly improved public health and environmental quality.

1.1 Need for study

The main purpose of wastewater treatment is for the treated wastewater to be able to be disposed or reused safely. However, before it is treated, the options for disposal or reuse must be considered so the correct treatment process is used on the wastewater.

2. METHODS

Waste water treatment plants employ a multi-stage process involving physical, chemical, and biological methods to remove pollutants from wastewater, typically categorized as preliminary, primary, secondary, and tertiary treatments.
Here's a breakdown of the common methods and stages:
1. Preliminary Treatment:
Screening: Removes large debris like rags, sticks, and other objects that could damage equipment.
Grit Removal: Removes inorganic solids like sand and gravel that settle out of the wastewater flow.

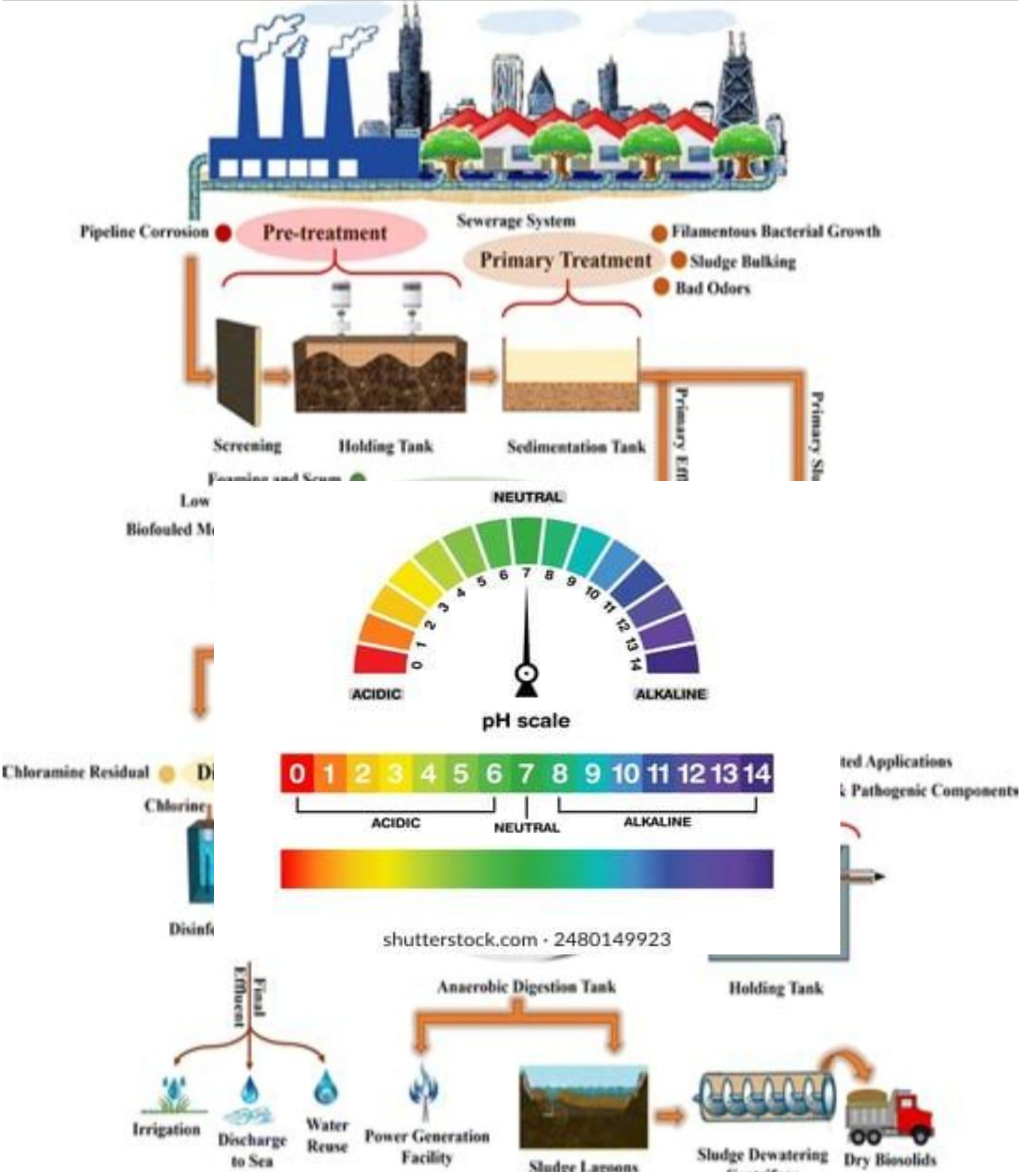
2. Primary Treatment:
Sedimentation: Allows solids to settle to the bottom of tanks, forming sludge, which is then removed.
Skimming: Removes floating materials like oil, grease, and scum.

3. Secondary Treatment:
Biological Treatment: Uses microorganisms to break down organic matter in the wastewater.
Activated Sludge Process: Wastewater is mixed with microorganisms, and air is pumped in to promote their growth and consumption of pollutants.
Trickling Filters: Wastewater trickles over rocks or media where microorganisms are attached, breaking down pollutants.
Rotating Biological Contactors: Rotating discs with attached microorganisms are submerged in wastewater, allowing for efficient pollutant removal.
Secondary Clarification: Further sedimentation to remove the remaining solids after biological treatment. 4.
Tertiary/Advanced Treatment: Filtration: Removes remaining suspended solids and pathogens using various filters (e.g., sand filters, membrane filters).
Disinfection: Kills harmful bacteria and viruses using methods like chlorination or ultraviolet radiation.
Nutrient Removal: Removes excess nutrients like phosphorus and nitrogen. Advanced Oxidation Processes: Uses chemicals like ozone or hydrogen peroxide to break down pollutants.
Membrane Filtration: Uses membranes to remove very fine particles and dissolved substances.

Reverse Osmosis: Uses pressure to force water through a membrane, separating out impurities.

3. EXPERIMENTAL WORK / ANALYSIS

Experimental work and analysis in wastewater treatment plants (WWTPs) involve studying various treatment processes and their effectiveness, including physical, chemical, and biological methods, to optimize treatment and ensure compliance with environmental regulations.
Here's a more detailed explanation:
1. Experimental Methods in Wastewater Treatment:
Pilot-Scale Studies: Researchers often use pilot-scale WWTPs to simulate full-scale operations



and test different treatment technologies under controlled conditions.
Laboratory Experiments: Laboratory experiments are conducted to analyze wastewater samples, assess the effectiveness of specific treatment processes, and determine optimal operating parameters. Field Studies: Field studies involve monitoring the performance of existing WWTPs and assessing the impact of treated effluent on the environment.
Mathematical Modeling: Mathematical models are used to simulate WWTP performance and predict the effectiveness of different treatment strategies.
2. Key Parameters Analyzed in Wastewater Treatment:
Physical Parameters:
Turbidity: Measures the cloudiness of the water, indicating the presence of suspended solids.
Temperature: Affects the activity of microorganisms involved in biological treatment.

pH: Measures the acidity or alkalinity of the water, which can affect the effectiveness of c ertain treatment processes.

Suspended Solids (SS): Measures the amount of non-dissolved solids in the water.
Chemical Parameters:
Chemical Oxygen Demand (COD): Measures the amount of oxygen required to chemically oxidize organic matter in the water.
Biological Oxygen Demand (BOD): Measures the amount of oxygen required by microorganisms to decompose organic matter in the water.
Total Organic Carbon (TOC): Measures the total amount of organic carbon in the water.
Oil and Grease (O&G): Measures the amount of oil and grease in the water.
Nitrogenous Compounds: Measures the amount of nitrogen compounds, such as ammonia, nitrates, and nitrites.
Phosphorus: Measures the amount of phosphorus compounds, which can contribute to eutrophication.
Biological Parameters:
Microbial Activity: Assesses the activity of microorganisms involved in biological treatment.
Microbial Community Structure: Identifies the types of microorganisms present in the wastewater treatment system

4. CASE STADY

BANSAL STP :-

there is a 9.5 MLD (Million Liters per Day) sewage treatment plant (STP) located near Bansal Hospital in Shahpura, Bhopal, as part of a larger initiative to improve water quality and sewage treatment across the city.

Here's a breakdown of the context and related information:

Location: The 9.5 MLD STP is situated near Bansal Hospital in Shahpura, Bhopal.
Capacity: The plant has a capacity of 9.5 MLD, meaning it can treat 9.5 million liters of sewage per day.
Bhopal Municipal Corporation Project: This STP is part of a larger project by the Bhopal Municipal Corporation to improve sewage treatment across the city.
Other STPs in the Project: The project includes other STPs with varying capacities, such as a 32 MLD STP at Sankhedi Kolar, a 20 MLD STP at Maksi, Kolar, and a 4.5 MLD STP at Char-Imli, Shahpura.
Project Goal: The initiative aims to improve the quality of water bodies and ensure effective sewage treatment in Bhopal.
Sewerage Network: The project also includes the construction of sewage pumping stations and laying of sewerage networks.
Other Projects: The National Green Tribunal report also mentions the Bhoj Wetland Project and the Kolar Project which include sewage treatment plants and other infrastructure.

5. CONCLUSION

The design of the wastewater treatment plant presented in this project aims to provide an efficient, cost-effective, and environmentally sustainable solution for managing wastewater. By incorporating primary, secondary, and tertiary treatment processes, the plant ensures the removal of physical, chemical, and biological contaminants to meet local discharge standards. Special attention was given to energy efficiency, sludge management, and the potential for water reuse and resource recovery.

Through careful planning and integration of modern treatment technologies, the proposed plant is capable of handling the projected wastewater load while minimizing environmental impact and operational costs. This design not only promotes public health and environmental protection but also supports long-term urban development and resilience against future population growth and industrial expansion.

6. REFERENCES

Metcalf & Eddy, Inc. (2023). Wastewater Engineering: Treatment and Resource Recovery, 6th Edition.

One of the most widely used textbooks in environmental engineering.

Includes in-depth design parameters, calculations, and process explanations.

U.S. EPA – Design Manual: Municipal Wastewater Treatment Plants.

EPA publication covering detailed design procedures and considerations.

American Water Works Association (AWWA) and Water Environment Federation (WEF) standards.

Includes guidelines on pipe sizing, treatment technologies, and plant operations.

British Standards (BS EN 12255) – Wastewater Treatment Plants – Series of Design Standards.Used in Europe for plant design, covering different units and safety.

Indian Standard Codes (IS 1172, IS 2065, IS 2490, CPHEEO Manual)

For wastewater plant design in India, especially urban areas.