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Planning and Design of Grey Water Treatment Plant

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Abstract: *The practice of treating and reusing wastewater from domestic tasks like laundry, dishwashing, and bathing is known as greywater treatment. Over time, this method has become more and more well-liked as a sustainable approach to water management, especially in areas where water is scarce. One of the most popular uses of this technology is the repurposing of greywater for irrigation. There are no serious health dangers when using greywater for non-potable uses like irrigating lawns, gardens, and plants. As a result, water use has less of an overall negative impact on the environment and lowers water bills.*

Greywater treatment Plant typically consist of a pre-treatment process to remove solids and other debris, followed by a filtration and disinfection stage to ensure the water is safe for use in irrigation. The most common types of greywater treatment systems are simple systems that use gravity to distribute water and more complex systems that involve pumps and sophisticated filtration mechanisms. One of the significant challenges associated with greywater treatment in irrigation is ensuring that the water is adequately treated to prevent health risks. Greywater contains various pollutants, including pathogens, bacteria, and chemicals, that can be harmful to human health and the environment if not adequately treated. Therefore, proper design, installation, and maintenance of greywater treatment systems are essential to ensure that the water is safe for use.

Keywords - *Greywater Treatment, Reuse, Sustainable Water Management, Treatment Plant, Water Conservation.*

I. INTRODUCTION

.Greywater, derived from washing machines, dishwashers, sinks, showers, and bathtubs, is a practical solution to save urban water supplies, especially during dry spells. Greywater reuse plants collect and redirect water from washing machines for fruit trees and decorative plants, ensuring their survival. However, it should not be used on edible crops near the ground due to potential harmful microorganisms, grease, or detergent residues. Greywater should be used within 24 hours of collection to prevent unpleasant smells and contaminants. Implementing greywater reuse in urban water plants benefits both water supply and wastewater sub plants by reducing demand for clean water and decreasing the volume of conveyed and treated wastewater.

Greywater, a significant portion of household wastewater, is a viable water source for reuse in households with flush toilets. Treatment involves collecting and directing wastewater from various appliances, excluding toilets, into a collection unit for non-potable use, using biological, chemical, and physical actions.

II. LITERATURE REVIEW

2.1 General:

A literature review is a crucial step for researchers to understand grey water plants and materials for treatment. It includes academic publications, books, articles, and relevant data. It's essential to understand the problem's status, practical solutions, and previous studies. Ineffective research may result from ignoring available online, book, and journal material.

2.2 Review of Journal Papers:

2.2.1 C.M. Narayan and Vikas Narayan, Biological wastewater treatment bioreactor design, (2019)-Biological wastewater treatment is a centuries-old biochemical process that is being investigated globally to improve efficiency and economy. The paper explores developments in biological-wastewatertreatment processes and bioreactor design for the Activated Sludge process, an industrial application of biotechnology. Despite its limitations, this process has undergone numerous modifications and diversification's to maintain its popularity.

2.2.2 Narges Shamabadi, Hasan Bakhtiari', The investigation and designing of anonsite grey water treatment plant at Hazrat-e-Masoumeh University, Qom, IRAN,(2015)-The water problem has been largely unaddressed in the past due to low population and consumption culture. However, industrialization, urbanization, and resource exploitation have led to increased erratic consumption. As global population increases and climate change worsens, finding new resources to reduce resource use is essential. This research explores grey water reuse as a recyclable resource.

2.2.3 Prof. Dr. Moermahadi Soerja Djanegara, CA, CPA, Research Project on Wastewater, (2019)-This research paper aims to provide information on sustainable wastewater management, identify opportunities for government policies and programs, and provide audit topics on wastewater issues based on SAIs' experiences. It highlights the lack of a universally recognized definition among various stakeholders, including engineers, town planners, researchers, and UN organizations.

2.2.4 VishnuVardhana Reddy, Srikanth yadav and Siva Kumar, Planning, and design of waste watertreatment plant for nandyal, (2019)- Many villages and cities suffer from diseases due to air pollution, water contamination, and untreated waste water. Contaminated water harms human health and aquatic life. Treatment units aim to reduce solids, remove nuisance elements, and change the sewage's character for safe discharge, allowing for parks and tree growth.

2.2.5 Sasan Kordrostrami, Waste-water treatment plant: Design, (2015)-Wastewater is a combination of water and waste from various uses, including industrial, commercial, and residential sources. It comes from two sources: community wastewater from domestic and commercial establishments, and industrial wastewater produced by industrial processes. To prevent pollution and protect public health, wastewater treatment uses chemical, physical, and biological processes to purify and discharge wastewater back into watercourses.

2.2.6 Nuralhuda Aladdin Jasim The design for wastewater treatment plant (WWTP) with GPS X modelling, (2020)-Wastewater treatment is a process that improves wastewater quality for drinking or other purposes. The Al-Hay wastewater treatment plant (WWTP) design considers criteria, physical, chemical, and biological characteristics. The project includes designing girt chambers, equalization basins, oil and grease removal, aeration tanks, and secondary settling tanks. GPS X modeling is used to create a typical diagram of the plant.

2.2.7 L. Benedetti, B. De Baets, I. Nopens, P.A. Vanrolleghem Multi-criteria analysis of wastewater treatment plant design and control scenarios under uncertainty,(2010)- The Benchmark Simulation Model no. 2 (BSM2) is a tool for evaluating long-term wastewater treatment plant control. It uses Monte Carlo simulations and multi-criteria evaluation to analyze process designs. Results show a cascade controller offers greater environmental and economic benefits. The volume of the primary clarifier and anoxic fraction impact process performance. Closed loop control leads to improved and more stable effluent.

2.2.8 MS. SHRADHA M. KALBURGI, MS. NEHA D. KESARE, MR. SANTOSH U. KUSHWAH, Review Paper on Treatment of Grey Water Using Low-Cost Technology, (2019)- Water scarcity is a global issue, with one in three people living in water scarcity by 2025. In developing countries, poor water quality is a major problem, causing livelihood and health issues. Low-cost technologies like stabilization tanks, filtration tanks, and root zone technologies can help manage grey water, which contains chemical, physical, and microorganism contaminants.

III. MATERIALS AND METHODOLOGY

3.1 Materials:

3.1.1 Coarse Aggregates:

Coarse aggregates, primarily consisting of gravel and crushed stone, are vital in concrete production, with a maximum size of 63 mm. These aggregates are sourced from stone quarries through blasting or manual crushing. Quality is essential, necessitating that they be clean, hard, and devoid of absorbed chemicals or clay. Coarse aggregates are defined as particles larger than 0.19 inches, typically ranging from 3/8 inch to 1 inch, with gravel being the predominant type used in concrete, supplemented by crushed stone.

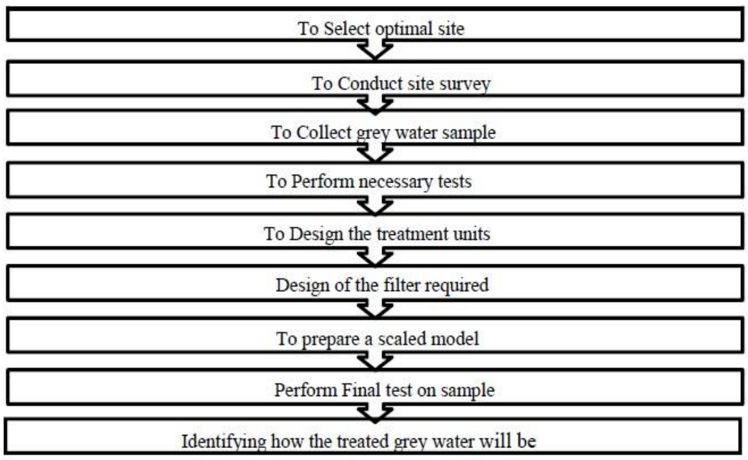
3.1.2 Godhra Sand:

Godhra sand is a crucial component in water filtration due to its fine texture and purity. It effectively traps and removes impurities, including suspended solids and sediment. It is used in rapid and slow sand filters, capturing and retaining impurities. This process improves water quality by removing contaminants, making it safe for drinking, irrigation, and industrial processes. The abundance of Godhra sand ensures a cost-effective filtration medium for water treatment facilities and communities.

3.1.3 Screen:

Screens, made from metal or plastic, are durable and versatile. Available in various sizes and configurations, they cater to various environments. The spacing between bars, ranging from 15 to 40 millimetres, is crucial for cleaning patterns and overall functionality. The configuration and material selection significantly impact the screen's effectiveness and longevity.

3.2 Methodology:



The setup of a grey water treatment plant involves several planned procedures to ensure its effectiveness and efficiency.

Identifying greywater sources in a home or project helps determine the amount and quality of greywater that can be collected and cleaned.

A survey must be conducted after site selection to determine the amount of grey water generated, including information on the number of apartments and society area.

The site collects meticulously collected samples from identified greywater sources to provide a representative evaluation, considering changes in quantity and quality over time.

The laboratory investigation of obtained samples is crucial for assessing their physical and chemical properties, providing insight into the quality and composition of greywater.

The grey water treatment and filtration plant design process begins after testing the grey water sample, considering filter selection and positioning for effective purification.

A model of the greywater Treatment plant is developed for better understanding and evaluation, allowing for necessary modifications and enhancements.

The final stage involves deciding on the use of treated greywater for non-potable purposes like landscape irrigation and tree watering, promoting water conservation and sustainability.

3.3 Testing on Waste Water Sample:

3.3.1 Ph Test:
The pH test is a crucial tool for assessing the quality of greywater, a byproduct of domestic tasks, which influences wastewater treatment processes and reuse suitability.

3.3.2 Odour Test:
The odor of wastewater is measured using an osmoscope and expressed as a Threshold Odour Number (TON). The TON is the dilution ratio at which the odor is barely detectable.

3.3.3 Colour Test:
A color test on wastewater measures the color of the water to assess its quality. The color of wastewater can be caused by dissolved and suspended materials, such as minerals, chemicals, algae, and particulates.

3.3.4 Temperature Test:
Wastewater temperature tests are important for monitoring the performance of wastewater treatment systems. The temperature of wastewater affects the activity of bacteria, which are used to break down organic matter in sewage.

3.3.5 Turbidity:
Greywater is a polluted source, containing various pollutants including soap, shampoo, toothpaste, laundry detergents, and chemicals. Turbidity tests measure water quality and monitor treatment plants.

3.3.6 Alkalinity:
The alkalinity experiment measures the amount of alkaline chemicals in grey water samples to determine its pH level for non-potable water applications. High alkalinity can cause issues like mineral precipitation and clogged pipes. The test helps determine if grey water needs treatment or adjustment for non-potable uses and is crucial for safe reuse in industrial or agricultural activities.

3.4 Survey:
Half of the main project's work has been completed, with a waste water treatment plant design in Gokul Township,Viral West. A poll was conducted on September 10, 2024, asking society officials about the number of flats in their neighborhood.

IV. OBSERVATIONS

4.1 Test Results

Sr.No.	Test Performed	Result	Permissible Ranges
1	Ph	7.8	6.5-8.5
2	Odour	Pungent	-
3	Colour	Light Grey	-
4	Temperture	20^o	-
5	Turbidity (NTU)	160.5	<10
6	Alkalinity (mg/L)	250	<200

Permissible Ranges reffered from Indian Standard 10500:2021 (IS CODE 10500:2021).

4.2 Survey Result:

Sr.No.	Name	No. of Flats
1	Society no.1	145
2	Society no.2	134
3	Society no.3	160
4	Society no.4	138
5	Society no.5	154

V. CONCLUSION

The test results indicate that the sample water's pH is 7.8, its color is light grey, its temperature is 200, and its odor is pungent. The sample water has a turbidity of 160.5 NTU and a final alkalinity of 250 mg/l.

According to the survey, there isn't a gray water treatment plant in existence. The construction of a gray water treatment facility is necessary. There are 145, 134, 160, 138, and 154 apartments in the society, for a total of 731 apartments.Assuming that there are four persons living in apartments on average and that each person generates 90 liters of grey water, 731 apartments produce 2,36,160 liters of grey water overall.

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