Review Paper on Grey Water treatment Plant for Residential Building

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Abstract -A study on domestic waste using characterization has been performed followed by the design of treatment plan (TP) gives brief description of collection, analysis, and treatment require for waste water from residential building. In first phase water is analysed for pH, Turbidity, Solids and BOD. Depending upon the test results we decided treatment process and design treatment plant for waste water and prepare the estimate and calculated cost for construction of treatment plant.

A treatment plant is quite necessary to receive the domestic and removes the materials which pose harm from general public and also for aquatic life. Its objective is to produce an environmentally-safe fluid waste stream (or treated effluent) and a solid waste (or treated sludge) suitable for disposal or reuse (usually as farm fertilizer). A sewage treatment plant has been designed with the treatment units, a screening tank, flock chamber, settling tank and chlorination tank.

1.INTRODUCTION

A greywater treatment plant is a system designed to treat and reuse wastewater from sources such as sinks, showers, and washing machines. Unlike black water, which is wastewater from toilets and kitchen-sinks, greywater is relatively clean and can be recycled for non-potable purposes like watering plants, flushing toilets, and cleaning.

Greywater treatment plants typically involve several stages of filtration and disinfection to remove contaminants and make the water safe for reuse. The exact process can vary depending on the specific system, but generally includes physical filtration, biological treatment, and disinfection.

Greywater treatment plants can offer many benefits, including reducing water usage, saving money on water bills, and reducing the strain on local water resources. Additionally, by reusing greywater, these systems can help reduce the amount of wastewater that is sent to treatment plants, reducing the overall environmental impact of wastewater disposal.

However, it is important to note that greywater treatment systems require proper installation, operation, and maintenance to ensure they function effectively and safely. It is also important to follow any local regulations and guidelines regarding the use of greywater.

1.1 Grey water volume generation.

The volume of greywater generated in India varies greatly depending on factors such as population density, water usage patterns, and access to water and sanitation infrastructure.

According to a study published in the journal "Resources, Conservation and Recycling" in 2015, the average daily greywater production per capita in Indian households was estimated to be around 35-45 liters. However, this can vary widely depending on factors such as the availability of water supply, access to sanitation facilities, and cultural practices related to water use.

In urban areas of India, where piped water supply and sanitation facilities are more prevalent, the volume of greywater generated is generally higher than in rural areas. The Indian government's Ministry of Housing and Urban Affairs estimates that the average daily domestic greywater generation in urban areas ranges from 70-90 liters per capita.

It is worth noting that these estimates are based on data from several years ago, and the volume of greywater generated in India may have changed due to factors such as population growth, urbanization, and changes in water use behaviour.

1.2 Need and benefits of grey water treatment.a

Need and benefits of grey water treatment:-

1. The treatment of grey water can provide several benefits, including:
2. Water conservation: Grey water treatment allows for the reuse of water that would otherwise be wasted. By recycling grey water for non-potable purposes such as irrigation or flushing toilets, it reduces the amount of freshwater required for these activities.
3. Cost savings: By reusing grey water, households and businesses can reduce their water bills and save money.
4. Environmental benefits: Grey water treatment helps to reduce the amount of wastewater that is sent to treatment plants, reducing the overall environmental impact of wastewater disposal.
5. Improved sanitation: Treating grey water can help to improve hygiene and reduce the risk of waterborne diseases by removing harmful pathogens and bacteria.
6. Increased resilience: In areas with water scarcity or unreliable water supplies, grey water treatment can provide a reliable source of water for non-potable uses.
7. Reduced strain on infrastructure: By reducing the demand for freshwater, grey water treatment can help to reduce the strain on water supply and treatment infrastructure.
8. In addition to these benefits, grey water treatment can also help to promote sustainable water management practices and raise awareness about the importance of water conservation.

1.3 How grey water Reuse?

Greywater reuse is the process of collecting, treating, and reusing wastewater from activities such as bathing, laundry, and dishwashing. Instead of being sent to a wastewater treatment plant or discharged into the environment, greywater is reused for non-potable purposes such as irrigation, toilet flushing, and cooling systems.

The process of greywater reuse involves collecting the water from the various sources in a separate plumbing system, then treating it to remove contaminants such as soap, oils, and chemicals. The treated water can then be used for various purposes such as landscape irrigation, toilet flushing, and cooling systems.

One of the main benefits of greywater reuse is the conservation of water resources. By reusing greywater, households and businesses can reduce their overall water consumption, which can have significant environmental and financial benefits. Additionally, greywater reuse can reduce the strain on local wastewater treatment facilities and reduce the need for new infrastructure.

Overall, greywater reuse is a sustainable and cost-effective way to conserve water resources and reduce the environmental impact of wastewater disposal.

1.4 Why grey water recycling?

Greywater recycling is the process of reusing household wastewater, such as from washing machines, sinks, and showers, for non-potable purposes like irrigation, toilet flushing, and washing cars. The benefits of greywater recycling include:

1. Water conservation: Greywater recycling helps to reduce the amount of freshwater used for non-potable purposes, which can conserve water resources and reduce strain on local water supplies.
2. Cost savings: By reusing greywater, households can reduce their water bills and potentially save money on wastewater treatment fees.
3. Environmental benefits: Recycling greywater reduces the amount of wastewater that is discharged into the environment, which can help to prevent pollution of waterways and reduce the energy and resources needed for wastewater treatment.
4. Improved soil health: Greywater can be used for irrigation, which can help to improve soil health and promote plant growth.

Overall, greywater recycling is a sustainable practice that can benefit both households and the environment.

2.METHODOLOGY

1. Filtration: This is a basic method that involves passing the greywater through various layers of filters like sand, gravel, and charcoal to remove impurities and solid particles.
2. Biological treatment: This method uses natural microorganisms to break down organic matter in the greywater. A bio-filter system can be used to remove pollutants from greywater, making it safe for reuse.
3. Chemical treatment: This involves the use of chemicals like chlorine to disinfect greywater. The process involves adding the chemical to the greywater and allowing it to react for a certain period of time.

4. Membrane filtration: This method involves using a membrane to filter out impurities in the greywater. The membrane acts as a barrier, allowing only clean water to pass through.
5. Constructed wetlands: This method involves using natural wetlands to treat greywater. The wetlands act as a natural filter, removing pollutants from the water.
6. Reverse osmosis: This method involves using a semi-permeable membrane to remove impurities from greywater. The membrane allows only pure water to pass through, leaving behind pollutants and other contaminants.
7. Ultraviolet treatment: This method involves using UV light to kill bacteria and other microorganisms in the greywater. The process is effective in removing impurities and making the water safe for reuse.

3.MATERIALS ARE USED IN GREY WATER TREATMENT PLABT

Grey water treatment systems typically use a variety of materials, including:

1. Filters: Filters are used to remove solid particles and debris from grey water before it enters the treatment system.
2. Coarse and Fine Media: Coarse and fine media, such as sand, gravel, and peat, are used in various stages of the treatment process to remove organic and inorganic pollutants.
3. Membranes: Membranes, such as microfiltration or ultrafiltration membranes, are used to separate and remove suspended solids and bacteria from grey water.
4. Activated Carbon: Activated carbon is used to remove organic compounds, such as volatile organic compounds (VOCs) and odour-causing compounds, from grey water.
5. Chemicals: Chemicals, such as chlorine or ozone, can be used in some grey water treatment systems to disinfect the water and kill harmful microorganisms.
6. Biological Treatment Units: Biological treatment units use microorganisms, such as bacteria or fungi, to break down and remove organic pollutants from grey water.

4.SCOPE OF GREY WATER TREATMENT

Greywater treatment refers to the process of treating and reusing wastewater from sources such as sinks, showers, and laundry. The scope of greywater treatment is vast and has significant environmental benefits.

The primary benefit of greywater treatment is the conservation of water. With the increasing demand for water, the reuse of greywater can help to reduce the strain on freshwater resources.

Greywater treatment can also reduce the environmental impact of wastewater discharge. By treating and reusing greywater, less wastewater is discharged into the environment, reducing the potential for pollution and environmental damage.

In addition, greywater treatment can also reduce the strain on sewage treatment plants. By diverting some of the wastewater from these plants, the facilities can operate more efficiently and cost-effectively.

Greywater treatment systems can be used in various settings, including residential, commercial, and industrial. They can range from simple, low-cost systems to more complex and sophisticated systems.

Overall, the scope of greywater treatment is significant, and the benefits of this practice are numerous. It can help to conserve water, reduce environmental impact, and improve the efficiency of wastewater treatment facilities.

5.RESULT AND DISCUSSION

Greywater is water that has been used in household activities such as washing dishes, laundry, and bathing. It can be reused for non-potable purposes such as irrigation, flushing toilets, and cleaning. However, greywater needs to be treated before reuse to remove harmful contaminants and pathogens.

There are several experiments that can be conducted for greywater treatment, including:

1.PH value:

PH value is the logarithm the reciprocal of hydrogen ion concentration. pH value can be determined by electronic method or colorimetric method.

Apparatus - Pocket size pH meter

Permissible limit – 6.5 to 8

Procedure

1.Preparation of Buffer solution

- Take 100ml of distilled water in a beaker
- Put the buffer tablet in distilled water

- Disperse the buffer tablet in the distilled water by continuously stirring action
- Prepare the buffer solutions of pH 4.0 and 9.2

2.Calibration of the instrument

The instrument should be calibrated before beginning the instrument.

- First rinse the electrode with distilled water and dry its bulb by using tissue paper.
- Dip the electrode in buffer solution of pH 7.
- Set the temperature (C) control to the room temperature.
- Set the function selector to pH position and adjust the CALIBRATE control until the meter displays the precise pH value of buffer solution.
- Now set the function selector switch to STAND by position.
- Remove the electrode from buffer solution. Wash it with distilled water and wipe out with tissue paper.
- Remove the above procedure for calibration with buffer solution 4.0 to 9.2.

3.Operation of the instrument

- Calibrate the pH meter with two standard buffer solutions as per the above procedure.
- Clean and rinse the electrode thoroughly with distilled water and carefully wipe with tissue.
- Dip the electrode into the sample solution. Stir the solution by keeping on magnetic stirrer or stir it manually.
- Wait upto one minute for steady reading +0.1 pH unit.
- Record reading in steady condition after one minute

Fig. Digital PH meter

Observation

Table.1.1 Observation for pH

Sr. No	Type of sample	Sample 1	Sample 2	avg
1	Waste water	7.9	8	9.5

2.Turbidity Test:

Turbidity – It is the presence of suspended particles in the sample. It is caused due to dissolved impurities in water. Its presence is parts per million of pure water. Turbidity of water can be measure with the aid of following instruments.

Apparatus used – Nephelometer

Other apparatus which are used to measure the turbidity

- Jackson turbiditimeter
- Turbidity rod
- Secchi disc
- Bayle's turbiditimeter
- Permissible limits – 5 to 10 (parts per million)

Cause of turbidity

- Phytoplankton
- Re-suspended sediments from the bottom
- Water discharge
- Algal growth
- Runoff

Impacts of turbidity

- The main impact is aesthetic; nobody likes the look of dirty water.
- It is also essential to eliminate the turbidity of water in order to effectively disinfect it for drinking purpose. This adds some extra cost the treatment of surface water supply.

Procedure:

By Digital (Nephelometric) Turbid meter

A.Reagent preparation
1.Dissolve 1.0gm Hydrazine sulphate in distilled water and dilute to 100ml in a volumetric flask.
2.Dissolve 10gm of Hexamethy lenetetramine in distilled water and dilute to 100ml in a volumetric flask.
3.Mix 5ml of each of the above solution (1) & (2) in a 100ml volumetric flask and allowed to stand for 24hrs at 25C +/- 3ºC and dilute to 1000ml.
4.This solution has turbidity of 40NTU.

B.Calibration of apparatus.
1.Switch on the instrument and wait till it warms up.
2.Selected appropriate range depending upon expected Turbidity of the given water sample.

- Set zero of the instrument with using distilled water (blank) and adjust to zero with set zero knob.
- Now in another test tube take standard suspension just prepared as in selection for 0 to 200NTU range, use 100NTU solution.
- Set display to the value of standard suspension with calibration knob.
- Now the instrument is ready to take measurement of any solution of unknown turbidity.

C. Operation of instrument
1.Switch on nephelometric turbidity meter and wait for few minutes till it warms up.
2.Set the instrument at 100 on the scale with a 40NTU std. Suspension.
3.Shake through the sample and keep it for some time to eliminate the air bubble.
4.Take sample in the sample tube, put it in the sample chamber and find out the value on the scale.

Fig. Turbidity meter.

Observation

Sample details		Turbidity (NTU)	Average turbidity (NTU)
Sewage	1	21.2	21.1
	2	21.0	

3.Biological Oxygen Demand (BOD)
The biochemical oxygen demand of sewage is the quantity of oxygen required for the biochemical oxidation of the decomposable matter at specified temperature within the specific time.
During natural decomposition, the life activities of organism are stimulated by high temperature and decreased at low temperatures. Therefore, the temperature and time during B.O.D. tests are testified.
Rapid BOD can be determined in two and a half days at 37ºC and this has been determined to be equivalent to the 5 days test day at 20ºC.

Significance:
Aerobic action continues as long as oxygen is present in the sewage. Oxygen for essential for the livelihood of an organisms. When the oxygen exhausts, the anaerobic action begins, due to which bad smell starts coming.
By increasing the percentage of oxygen, length of aerobic can be increased.

Uses of BOD test:
To determine the quantity of oxygen that will be required to biologically stabilize the organic matter present.
To determine the size of wastewater treatment facilities.
To measure the efficiency of treatment plant.

Measurement of BOD:
By dilution method: Dilution of water is done by aerating the distilled water to saturate it with oxygen that be sufficient for five days.

Nutrients are added in dilution water and dilution of sample is prepared.
Initial DO of incubated sample instantly and one bottle is kept in incubator at 20°C for five days period for incubator.
Final DO of incubated sample is determined after 5 days.

Similarly determined DO consumption for plain dilution water as a blank
BOD at 20c in mg/l = (D1-D2)-(B1-B2)
Where;
D1: Initial DO of sample
D2: Final DO of sample
B1: Initial DO of blank
B2: Final DO of blank

BOD values are always expressed as BOD 5(5 days BOD) at 20c, in mg/l the explanation for which is given below.

Fig 3.1: BOD Graph

Within 5 days period, about 60 to 70% biochemical oxidation is completed. Within 20 days period it is about 80 to 100% completed. As biochemical oxidation is a slow process it take an infinite time for completion. Providing larger period for BOD determination is not convenient there for 5 days period is adopted for BOD test.
20c temperature is used as an average valve for slow moving streams in temperate climate and can be easily duplicated in an incubator the rate or biochemical reaction increased with temperature and BOD values determined at different temperature will be different.

Fig.BOD Incubator.

Observation

Table. 3.1 observation of(BOD)

Sample	Volume of Sample	Bottle No	D.O meter reading		Differenc e in D.o
Tap water	500	Blank(B1)	4.8	4.0	1.4
Sewage	500	Dilute(D1)	5.6	4.2	

5.CONCLUSION

Greywater treatment is an effective way to conserve water resources and reduce the strain on sewage systems. Greywater is water that has been used for activities like washing clothes, dishes, and bathing, but does not include wastewater from toilets. Greywater can be treated and reused for non-potable purposes such as watering plants, flushing toilets, or washing clothes.

Greywater treatment involves a number of steps, including filtration, disinfection, and storage. The specific treatment methods used will depend on the quality of the greywater and the intended use.

Overall, greywater treatment is a sustainable and cost-effective solution for water conservation. It helps to reduce the demand for fresh water and also reduces the amount of wastewater that needs to be treated by sewage systems. However, it's important to note that greywater treatment should only be carried out by professionals with proper training and equipment to ensure safe and effective treatment.

REFRENCES

There are many resources available on grey water treatment, including books, research papers, and online articles. Here are a few references to get us started:

1. "The Water-Wise Home: How to Conserve, Capture, and Reuse Water in Your Home and Landscape" by Laura Allen. This book provides practical advice on grey water treatment and reuse, as well as other water conservation strategies.
2. "Greywater, Green Landscape: How to Install Simple Water-Saving Irrigation Systems in Your Yard" by Laura Allen. This book focuses specifically on using grey water for landscape irrigation and provides step-by-step instructions for installation.
3. "Guidelines for the Safe Use of Wastewater, Excreta and Greywater" by the World Health Organization. This publication provides technical guidance on the safe use of wastewater, excreta, and grey water in agriculture and aquaculture.
4. "Greywater Treatment Systems for Homeowners" by the University of Arizona Cooperative Extension. This publication provides an overview of different types of grey water treatment systems and their costs, as well as tips for maintaining and using them effectively.
5. "Greywater Reuse: A Review of Best Practice" by the Water Research Commission. This research paper provides a comprehensive review of grey water reuse best practices, including treatment methods and case studies from around the world.