Optimization and Analysis of Physicochemical Parameters in Treated Grey Water

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Abstract: This study evaluates the properties of treated grey water through a filtration system made of pebbles, charcoal, gravel, sand, and cotton. Samples from a boys' hostel underwent filtration and were tested for alkalinity, acidity, pH, and chloride content. Results showed significant water quality improvements, making the treated grey water suitable for non-potable uses like irrigation and toilet flushing. This research highlights the potential of grey water reuse to address water scarcity and promote sustainable water management.

Keywords: Grey water, Water Treatment, Physicochemical Analysis, Sustainability, Filtration System, Water Quality, Non-Potable Water Reuse, Environmental Conservation.

I .INTRODUCTION

General

Grey water refers to wastewater generated from domestic activities such as bathing, dishwashing, and laundry, excluding waste from toilets. Globally, it constitutes a significant portion of household wastewater, accounting for nearly 50-80% of total water usage in residential settings. With increasing pressure on freshwater resources due to urbanization and climate change, grey water recycling presents an attractive solution for water conservation and environmental sustainability.

Grey water, when properly managed and treated, can be a valuable resource for various non-potable applications. It is rich in essential nutrients like phosphorus and nitrogen, making it particularly suitable for agricultural and horticultural use. However, untreated grey water can also pose significant environmental and health risks due to the presence of organic matter, pathogens, and chemical contaminants. Addressing these challenges requires the development of efficient treatment systems that ensure the safe reuse of grey water.

The recycling and reuse of grey water have several advantages. It reduces the load on municipal sewage systems, decreases the demand for freshwater, and promotes a circular approach to water management. For instance, treated grey water can be utilized for irrigation, toilet flushing, and landscaping, thus conserving high-quality freshwater for essential needs like drinking and cooking. Moreover, it aligns with the principles of sustainable development by reducing wastewater discharge into natural water bodies, thereby minimizing pollution and protecting aquatic ecosystems.

This study explores grey water treatment using a multi-layered filtration system composed of pebbles, charcoal, gravel, sand, and cotton. By analysing key physicochemical parameters such as pH, alkalinity, acidity, and chloride content, the research aims to evaluate the efficacy of the proposed filtration method. The findings of this study contribute to the growing body of knowledge on grey water management and provide practical insights into designing cost-effective and sustainable water treatment solutions.

II. Materials & Methodology

Materials

2.1.1 Pebbles

- Pebbles filter large debris, reducing the load on subsequent layers.
- Coarse texture traps solids, ensuring effective mechanical filtration.
- Essential initial step for cleaner grey water.
- Requires regular cleaning to sustain efficiency.
- Promotes efficient removal of larger impurities.

Fig.1 (pebbles)

2.1.2 Charcoal (First Layer)

- Activated charcoal absorbs impurities and odors from grey water.
- First charcoal layer removes residual chemicals and pollutants.
- Porous structure enhances adsorption capabilities.

Fig.2 (charcoal)

2.1.3 Gravel

- Gravel filters larger particles, preventing clogging.
- Coarse composition ensures smooth water flow.
- Provides habitat for beneficial microorganisms.
- Requires regular inspection and cleaning.
- Forms part of a multi-layered filtration system.

Fig.3 (gravel)

2.1.4 Charcoal (Second Layer)

- Second charcoal layer targets remaining impurities.
- Adsorption properties capture fine particles and chemicals.
- Enhances water quality for non-potable uses.
- Requires regular monitoring and replacement.
- Improves overall purification through dual layers.

Fig .4 (charcoal)

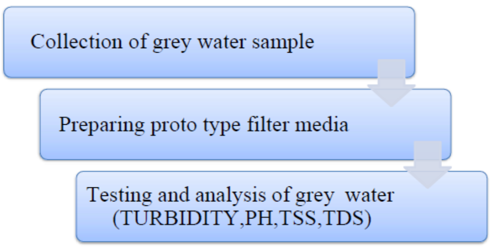
2.1.5 SAND AND COTTON

- Sand filters smaller particles for water clarity.
- Cotton acts as a biological filter, aiding organic matter decomposition.
- Combined action ensures production of relatively clean water.
- Suitable for various non-potable purposes.
- Requires regular maintenance for sustained efficiency.

Fig.5 (sand)

Fig.6 (cotton)

METHODOLOGY



- Sampling: Water samples were collected from a boys' hostel for analysis.

- Filtration System: Grey water was passed through sequential layers of pebbles, charcoal, gravel, sand, and cotton.
- Testing: Treated water was analysed for alkalinity, acidity, pH, and chloride content.


Fig 7 – GREY WATER


Fig 8 – COLLECTION OF GREY WATER


Fig 9 – SETTLEMENT OF THE MATERIAL


Fig 10 – PROTOTYPE FILTER MEDIA


Fig 11 – POURING OF GREY WATER


Fig 12 – COLLECTION OF TREATED GREY WATER


Fig 13– TESTING OF TREATED GREY WATER

RESULTS AND DISCUSSION

The study showed significant improvements in treated grey water quality:

- Chloride: Reduced to acceptable levels (≤250 mg/L).
- Alkalinity: Adjusted to non-corrosive levels (≤200 mg/L).
- pH: Maintained between 6-9, suitable for irrigation.
- Acidity: Major reduction for safe reuse.

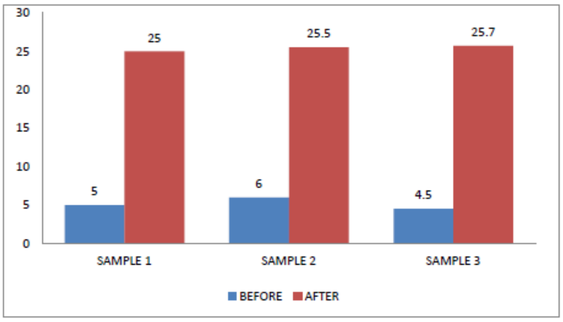
Key Findings

Treated grey water met quality standards for non-potable uses, including irrigation, toilet flushing, and industrial processes, providing economic and ecological benefits.

Different Test Conducted On Grey Water

TABLE 1: CHLORIDE CONTENT (mg/liter) (within 250mg/liter)

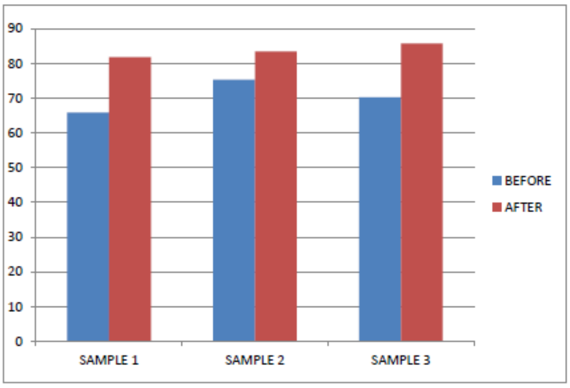
SAMPLE	BEFORE	AFTER
SAMPLE-1	5	25
SAMPLE-2	6	25.5
SAMPLE-3	4.5	25.7



GRAPHICAL REPRESENTATION ON CHLORIDE CONTENT TEST

TABLE 2: ALKALINITY (mg/liter) (less than 200mg/liter)

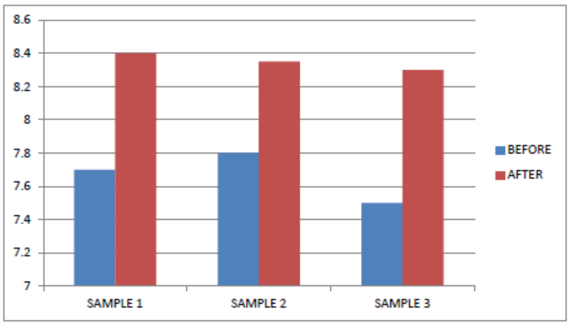
SAMPLE	BEFORE	AFTER
SAMPLE-1	65.8	81.8
SAMPLE-2	75.3	83.4
SAMPLE-3	70.2	85.7



GRAPHICAL REPRESENATION ON ALKALINITY TEST

TABLE 3: pH VALUE (not be less than 6)

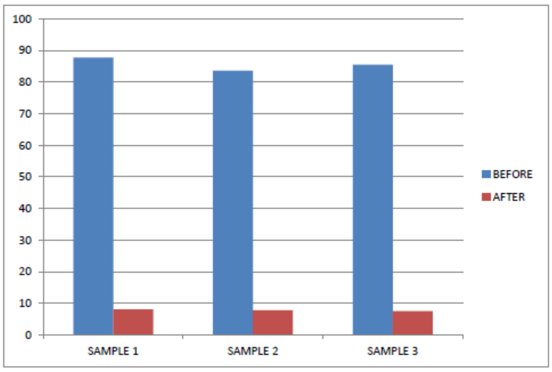
SAMPLE	BEFORE	AFTER
SAMPLE-1	7.7	8.4
SAMPLE-2	7.8	8.35
SAMPLE-3	7.5	8.3



GRAPHICAL REPRESNTATION OF pH VALUE TEST

TABLE 4: ACIDITY (mg/liter) (within 60mg/liter)

SAMPLE	BEFORE	AFTER
SAMPLE-1	87.8	8
SAMPLE-2	83.6	7.8
SAMPLE-3	85.5	7.5



GRAPHICAL REPRESENTATION ON ACIDITY

IV. CONCLUSIONS

The treatment system effectively improves grey water quality, making it suitable for various non-potable applications. This approach supports water conservation, reduces reliance on freshwater sources, and promotes environmental sustainability. Incorporating grey water reuse systems can mitigate water scarcity and foster sustainable resource management.

V. REFERENCES

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