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"USE OF COCONUT SHELL AS CAPPING FOR SAND IN RAPID SAND FILTERS FOR LOW-COST WATER PURIFICATION"

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ABSTRACT

Access to safe drinking water remains a major challenge in many developing countries. Conventional water treatment systems require significant infrastructure, making them unsuitable for rural areas. This research focuses on the development of a low-cost water purification technique using coconut shell as a capping media in rapid sand filters. Coconut shells possess natural adsorption properties due to their porous structure and large surface area.

In this study, a filtration system consisting of coconut shell, sand, gravel, and pebbles was designed and evaluated. Water samples were analyzed before and after filtration for parameters including turbidity, hardness, pH, odor, and color. The results showed that turbidity was reduced from 40–50 NTU to approximately 5 NTU, indicating nearly 90% removal efficiency. The pH value improved from 8 to 6.5, while hardness decreased from 150 mg/L to 100 mg/L.

The study demonstrates that coconut shell-based filtration systems can provide an effective and sustainable solution for water purification in rural and low-income communities.

Key Words: *Water Purification, Coconut Shell, Rapid Sand Filter, Adsorption, Low-Cost Filtration, Rural Water Treatment.*

I. INTRODUCTION

Clean and safe drinking water is essential for human survival and public health. However, millions of people around the world lack access to safe drinking water, particularly in developing countries. According to global water statistics, water contamination contributes to millions of deaths each year due to waterborne diseases.

Rapid Sand Filters (RSF) are widely used in water treatment plants due to their high filtration rate and efficiency. However, conventional filter media such as activated carbon and synthetic materials can be expensive. Therefore, researchers are exploring natural and low-cost filtration media.

Coconut shell is an agricultural waste material that has high adsorption capacity and porous structure. These characteristics make it suitable for removing contaminants from water. The use of coconut shell as a capping layer over sand filters can enhance filtration efficiency while maintaining low cost.

This research investigates the feasibility of using coconut shell as a natural filtration medium in rapid sand filters for improving water quality.

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II. LITERATURE REVIEW

Several studies have investigated the use of natural materials in water purification systems.
Samdin (2015) studied the use of coconut shell activated carbon for removal of organic contaminants from drinking water. The study showed that coconut shell carbon effectively reduced odor and organic pollutants.
Karnapa Ajit (2016) reviewed grey water treatment methods and highlighted the importance of low-cost filtration systems for rural communities.
Amabadi et al. (2015) analyzed wastewater treatment systems and concluded that filtration combined with adsorption can significantly improve water quality.
Pushkar Singh et al. (2015) studied grey water reuse and emphasized the importance of sustainable water purification technologies.
These studies confirm that natural filtration media such as coconut shells can provide cost-effective alternatives to conventional water treatment materials.

III. OBJECTIVES OF THE STUDY

The major objectives of the project are:

1. To study existing water filtration techniques.
2. To design a **low-cost water purification system** using natural materials.
3. To evaluate the filtration efficiency of coconut shell media.
4. To analyze water quality before and after filtration.

To develop an affordable filtration system for rural communities.

IV. MATERIALS USED

The following materials were used in the filtration system.

1 Coconut Shell

Coconut shells act as an adsorption media due to their porous structure and high surface area. They help remove organic compounds, chlorine, and odor from water.

2 Sand

Sand is widely used as a filtration medium due to its porosity and ability to trap suspended particles.

3 Gravel (20 mm Aggregate)

Gravel supports the sand layer and improves filtration efficiency by preventing clogging.

4 Pebbles

Pebbles provide structural support to the filtration bed and maintain proper water flow.

5 Activated Carbon

Activated carbon improves adsorption capacity and enhances removal of contaminants.

V. METHEDOOGY

The research methodology involved the following steps:

1. Collection of water samples
2. Measurement of initial water quality parameters
3. Fabrication of filtration system
4. Passing water through the filter media
5. Testing treated water parameters
6. Comparing results before and after filtration

The filtration unit consisted of layered media arranged as:

- Coconut shell layer

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- Sand layer
- Gravel layer
- Pebble layer

Water passed through these layers and contaminants were removed through adsorption and filtration processes.

VI. Experimental Results

The following table summarizes the water quality parameters before and after filtration.

Parameter	Before Filtration	After Filtration
Color	Muddy Grey	Colorless
Odor	Rotten egg smell	No odor
Turbidity	40–50 NTU	5 NTU
Hardness	150 mg/L	100 mg/L
pH	8	6.5
VOCs	0.6 mg/m³	0.5 mg/m³

The results indicate significant improvement in water quality after filtration.

VII. Graphs (For Journal Figures)

The following graphs should be included in the paper:
Figure 1: Turbidity Removal Efficiency
Before filtration = 45 NTU
After filtration = 5 NTU
Figure 2: Hardness Reduction
Before filtration = 150 mg/L
After filtration = 100 mg/L
Figure 3: pH Variation
Before filtration = 8
After filtration = 6.5
These graphs demonstrate the effectiveness of the coconut shell filtration system.

VIII. Photographs

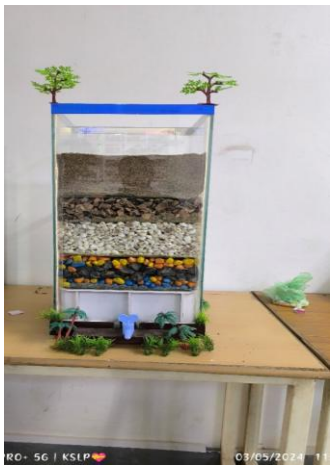

Figure 1 Experimental setup figures.

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IX. Discussion

The results demonstrate that coconut shell can be effectively used as a filtration media in rapid sand filters. The porous structure of coconut shell enhances adsorption of contaminants, resulting in improved water quality.
The combination of coconut shell with sand filtration provides a dual purification mechanism:

1. Physical filtration by sand
2. Chemical adsorption by coconut shell

This hybrid approach improves contaminant removal efficiency while maintaining low operational cost.

X. Conclusion

The study demonstrates that coconut shell can be successfully used as a capping media for sand in rapid sand filters for water purification.
The developed filtration system showed significant improvements in water quality parameters such as turbidity, hardness, and pH. The system is cost-effective, environmentally friendly, and suitable for rural applications.
The use of locally available materials like coconut shells makes this system sustainable and economically viable for developing regions.
Future research can focus on optimizing filtration media thickness and evaluating long-term performance

REFERENCES

[1] Ajit Karnapa (2016) Review on Grey Water Treatment and Reuse.
[2] N. Amabadi et al. (2015) On-site Greywater Treatment System Design.
[3] Sandhya Pushkar Singh (2015) Grey Water Treatment Process Review.
[4] Vijaya V. Shegokar (2015) Wastewater Treatment Analysis.
[5] Amr M. Abdel-Kader (2013) Greywater Treatment by RBC System.
[6] Lambe J.S. & Choughule R.S. (2015) Reduce Reuse Recycle of Greywater.
[7] Metcalf & Eddy (2014) Wastewater Engineering: Treatment and Reuse.
[8] Crittenden J.C. (2012) Water Treatment Principles and Design.
[9] WHO (2017) Guidelines for Drinking Water Quality.
[10] BIS 10500 (2012) Drinking Water Quality Standards.
[11] APHA (2017) Standard Methods for Water Examination.
[12] Montgomery J.M. (1985) Water Treatment Principles.
[13] Tchobanoglous G. (2014) Water Supply Engineering.
[14] Hammer M.J. (2012) Water and Wastewater Technology.
[15] Peavy H.S. (1985) Environmental Engineering.
[16] Davis M.L. (2010) Water and Wastewater Engineering.
[17] Arora K.R. (2010) Environmental Engineering.
[18] Qasim S.R. (2000) Wastewater Treatment Plants.
[19] IRC Water Treatment Manual (2015).
[20] UNICEF (2019) Global Drinking Water Report.