

STUDY ON TREATING OF WASTEWATER BY USING NATURAL FILTERS

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ABSTRACT: *This paper deals with the Study on treatment of wastewater by using natural filters which plays an important role in conservation of water for hotels and household, through an innovative filtration system. The aim of the paper deals with the proper arrangement of natural filter material, finding the thickness of each layer and effective purification mechanism of wastewater reuse. The filter materials used includes coconut fibers, natural antibacterial plants (neem leaf powder), zeolite molecules, maifan stone, fine sand, Granulated activated charcoal and cotton, this system efficiently removes a broad spectrum of pathogens and chemicals from complex wastewater matrices. Initially a prototype of natural filter was assembled to know the thickness of each layer of filter materials by visual monitoring of the filtration process. Then 1 liter of bathroom wastewater was collected before and after the filtration process and tested for various physical, and chemical parameters of water. The tested wastewater results were found to reduce in total dissolved solids (TDS), hardness, alkalinity, chloride, and other dissolved substances, which are essential for enhancing water quality and making it suitable for various gardening and flushing purposes.*

Keywords: *Wastewater Treatment, Filtration System, natural filter materials, zeolite molecules, maifan stone, pathogens and chemical*

I. INTRODUCTION

As the need for clean and accessible water rises, innovative approaches using natural filter materials have emerged as promising solutions. This system harnesses the inherent properties of diverse natural elements, such as zeolite molecules, activated carbon, sand, coconut fibers, natural antibacterial plants, and maifan stone, to create an efficient water filtration structure. By strategically layering these materials, this filtration method aims to remove impurities, heavy metals, organic compounds, and microbial threats from water sources. this introduction explores the layered arrangement and functionality of each material within this eco-friendly filtration system.

II. OBJECTIVES

The main objective is to establish a sustainable source of wastewater treatment by using natural filters which is eco-friendly and effective in removing harmful bacteria and chemicals for domestic purpose like flushing, washing and gardening.

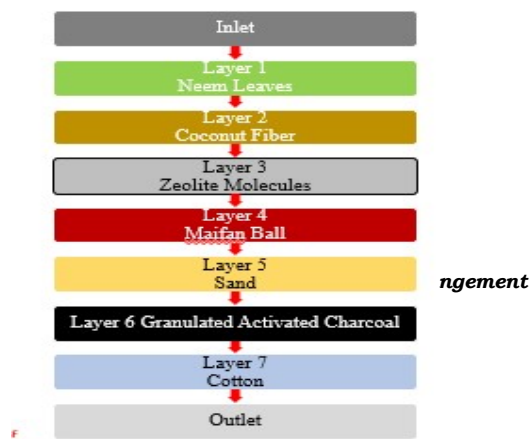
III. MATERIAL USED

The materials used in making natural filter coconut fibers, natural antibacterial plants (neem leaf powder), zeolite molecules, maifan stone, fine sand, Granulated activated charcoal and cotton.

1. **Coconut Fibers:** Acting as a physical barrier for impurities, coconut fibers provide an effective means of filtration for larger particles and debris in the water.
2. **Natural Antibacterial Plants (Neem Leaf):** With natural antibacterial properties, neem leaf is instrumental in combating pathogenic bacteria present in wastewater. It enhances the biological safety of the treated water.
3. **Zeolite Molecules:** Zeolite molecules serve as a molecular sieve for selective removal of specific contaminants. Their inclusion enhances the overall selectivity and efficiency of the filtration system.
4. **Maifan Stone:** Maifan stone plays a crucial role in ion-exchange and heavy metal adsorption. It helps remove harmful metals present in wastewater, contributing to the overall purification of the water.
5. **Sand:** Sand with its porous structure, facilitates the adsorption of bacteria. It acts as an effective filter for bacterial contaminants, contributing to the overall microbial purification of the water.
6. **Granulated Activated Charcoal:** Granulated Activated Charcoal is versatile in adsorbing a wide range of chemicals present in wastewater, including organic compounds and other contaminants. It enhances the chemical purification of the water.
7. **Cotton:** Cotton is a natural, highly absorbent, and biodegradable cellulose fiber used in filtration for its high porosity, ability to retain particles, and chemical resistance to organic solvents. Used as a filter bed or material for adsorbing impurities.

IV. METHODOLOGY

Initially a prototype was assembled in a transparent bottle, following a predetermined layering sequence as outlined in flow chart as shown in below.

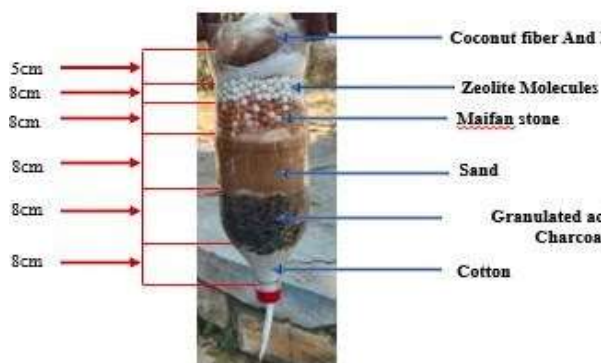


Each material was carefully packed to ensure efficient

filtration. The transparent design allowed for visual monitoring of the filtration process, enabling the team to observe the water flow and filtration outcomes in real-time.

Create a detailed design for the filtration system, including the transparent bottle and layering sequence. Gather all necessary materials, including maifan stone molecules, zeolite molecules, activated carbon, cotton, coconut fiber, neem leaf, and sand.

Assemble the prototype according to the design and layering sequence, ensuring that each material is carefully packed for efficient filtration. Throughout the prototype development process, it is important to document each step and any changes made to the design or layering sequence. This will help to ensure that the filtration system is replicable and can be improved upon in the future.



Fig; 4.2 prototype

4.1 EXPERIMENTAL TRAILS:

- For the first trail all material were placed in 3 cm each layer and when waste water passed into it there were no change in pH and colour of the water didn't change
- For the second trail all materials were placed in 5 cm each layer and when waste water passed into it there was change in pH and colour but water was slightly colored
- For the third trail all the material were placed in 8 cm each layer and when waste water passed into it, we overserved there were much difference in pH and colour of the water were visibly clear. And for further test water sample were given to testing center and final experimental results shown in table 4.1.1.





Fig 4.4: final project model

4.2 TESTING PROCESS:

1. Sample Collection: A 1-liter sample of Bathroom wastewater was collected for testing, representing a typical scenario for the filtration system's intended use.
2. When determining the flow rate of a filtration system, it is essential to consider the time duration required for the filtration of a specific volume of water. In this scenario, the filtration of 1 liter of water takes 1 hour to complete. However, it is noteworthy that water begins to emerge from the outlet after 10 minutes of initiating the filtration process.
3. PH Testing: The initial PH measurement of the wastewater sample provided a baseline for assessing the effectiveness of the filtration process. The PH range of 8.5-9 indicated the initial acidity level of the untreated wastewater.
4. Filtration Process: The gradual penetration of the wastewater through each layer of material demonstrated the system's filtration efficiency. The time taken for complete penetration and the subsequent filtration process highlighted the system's performance in treating the wastewater.
5. Filtration Outcome: The transformation of the milky white, odorous wastewater into colourless, odourless filtered water showcased the successful removal of impurities and contaminants by the filtration system.
6. PH Testing of Filtered Water: The final PH measurement of the filtered wastewater falling within the range of 7-7.5 indicated the neutralization of acidity and the successful purification of the water.

4.3 TEST RESULTS

Test results are tabulated below:

Table:4.1.1: Test result of wastewater sample before and after filtration process

SL NO	Parameters	Before	After	Units
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1	COLOUR	<2.0	<2.0	Hz
2	Turbidity	<0.5	<0.5	NTU
3	pH	8.02	7.35	-
4	Electrical Conductivity	2210	2210	μS/cm
5	Total Dissolved Solids	1326	1100	mg/l
6	Total alkalinity (as CaCO ₃)	656.7	597.0	mg/l
7	Total hardness (asCaCO ₃)	653.9	594.5	mg/l
8	CALCIUM(CA)	199.9	179.9	mg/l
9	Magnesium (as Mg)	38.5	36.1	mg/l
10	Chloride(ask)	664.3	500.3	mg/l
11	Sulphate (as SO ₄)	48.2	46.2	mg/l
12	Nitrate (asNO ₃)	46.8	45.0	mg/l
13	Fluoride (as F)	<0.1	<0.1	mg/l
14	Iron (as Fe)	<0.02	<0.02	mg/l
15	Free residual chlorine	<0.1	<0.1	mg/l

SL. No	TEST PARAMETER	UNITS	Before	After
1	Escherichia coli	100 ml	Present	Present
2	Total coliforms	100 ml	Present	Present

V. RESULT AND DISCUSSION:

1. Colour: The colour remained consistent and below the limit of 2.0 Hz before and after treatment, indicating good clarity of the water.
2. Turbidity: The turbidity also remained consistent and below the limit of 0.5 NTU before and after treatment, confirming clear water quality.
3. pH: The pH decreased from 8.02 to 7.35 after treatment. This shift towards a slightly lower pH suggests a reduction in alkalinity, which could be beneficial for certain water uses.
4. Electrical Conductivity: The electrical conductivity remained unchanged at 2210 μS/cm before and after treatment, indicating consistency in dissolved ion concentrations.
5. Total Dissolved Solids (TDS): The TDS concentration decreased from 1326 mg/l to 1100 mg/l after treatment, indicating a reduction in dissolved substances in the water, which is favorable for water quality.
6. Total Alkalinity: The total alkalinity decreased from 656.7 mg/l to 597.0

- mg/l after treatment, suggesting a decrease in the water's buffering capacity.
7. Total Hardness: The total hardness decreased from 653.9 mg/l to 594.5 mg/l after treatment, indicating a reduction in calcium and magnesium ion concentrations.
 8. Calcium (Ca): The calcium concentration decreased from 199.9 mg/l to 179.9 mg/l after treatment, which is beneficial for water softening.
 9. Magnesium (as Mg): The magnesium concentration decreased slightly from 38.5 mg/l to 36.1 mg/l after treatment.
 10. Chloride (as Cl): The chloride concentration decreased significantly from 664.3 mg/l to 500.3 mg/l after treatment, which is important for reducing salinity.
 11. Sulphate (as SO₄): The sulphate concentration decreased slightly from 48.2 mg/l to 46.2 mg/l after treatment.
 12. Nitrate (as NO₃): The nitrate concentration decreased slightly from 46.8 mg/l to 45.0 mg/l after treatment.
 13. Fluoride (as F): The fluoride concentration remained below the detection limit (<0.1 mg/l) both before and after treatment.
 14. Iron (as Fe): The iron concentration remained below the detection limit (<0.02 mg/l) both before and after treatment.
 15. Free Residual Chlorine: The free residual chlorine concentration remained below the detection limit (<0.1 mg/l) both before and after treatment.

Based on the test results for Escherichia coli (E. coli) and total coliforms before and after treatment.

1. **Escherichia coli (E. coli):** The presence of E. coli was observed both before and after treatment, indicating that the treatment process did not effectively eliminate this bacterium. According to the IS: 10500-2012 standard, E. coli should be absent in 100 ml of water for it to meet the safety requirements for various uses, including drinking water.
2. **Total Coliforms:** Similarly, the presence of total coliforms was detected both before and after treatment, suggesting that the treatment process did not sufficiently reduce the overall coliform bacterial load in the water. As per the IS: 10500-2012 standard, total coliforms should also be absent in 100 ml of water to ensure its suitability for consumption and other uses.

VI. CONCLUSION

- The water treatment process successfully improved key physicochemical parameters such as total dissolved solids (TDS), hardness, alkalinity, and chloride, resulting in enhanced water quality suitable for general purposes including irrigation, industrial use, and recreational activities.
- Despite these improvements, the persistent presence of Escherichia coli (E. coli) and total coliforms in the treated water indicates ongoing microbial contamination issues, highlighting the need for additional measures to address microbial concerns.
- Further enhancements, such as implementing advanced disinfection

techniques or enhancing filtration processes, may be required to achieve microbial quality standards suitable for specific applications, ensuring the water's safety and suitability for diverse purposes excluding drinking.

- The treated water can be considered safe and effective for general non potable uses; however, caution is advised against using it for drinking purposes due to microbial considerations.

FUTURE SCOPE:

The filtered wastewater can be tested for DO, COD, BOD and also, it can be further studied for removing E-coli and total coliforms present in wastewater filtration process.

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