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Purification of Waste Water Using Coconut Fiber and Rice Husk as Activated Carbon

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ABSTRACT

Adsorption with activated carbon is often used as purification for the removal of pollutants such as COD, TSS, TDS, turbidity, and color from wastewater. Activation enhances the adsorption power of the product obtained from the carbonization stage. Mostly used activation agents are zinc chloride, potassium sulphide, potassium thio sulphate, phosphoric and sulphuric acid. Activated carbon is expensive for large-scale wastewater treatment; hence, low-cost adsorbents such as rice husk and coconut fiber offer a sustainable alternative. These materials are environmentally friendly, economical, and widely available. This project evaluates the efficiency of coconut fiber ash and rice husk ash in wastewater purification.

Keywords: Activated Carbon, Rice Husk, Coconut Fiber, Wastewater Treatment, Adsorption

1. INTRODUCTION

Water resources worldwide are increasingly contaminated due to domestic, agricultural, and industrial activities. Cost-effective treatment methods such as adsorption, sedimentation, and coagulation using natural coagulants have gained importance. Activated carbon produced from rice husk and coconut fiber shows strong adsorption capacity, making these materials suitable for wastewater treatment applications.

1.1 OBJECTIVES

- To analyse the characteristics of wastewater.
- To fabricate activated carbon from coconut fiber and rice husk.
- To investigate their pollutant removal efficiency.
- To determine optimum conditions for maximum pollutant removal.
- To compare performance at different proportions.

1.2 SCOPE OF THE PROJECT

Population growth and industrialization have resulted in increased wastewater generation. Low-cost wastewater treatment solutions are essential. Coconut fiber and rice husk ash act as natural bio-adsorbents for removing impurities such as pH, turbidity, TSS, TDS, and BOD. This study evaluates their efficiency in treating domestic wastewater.

2. METHODOLOGY

The methodology includes wastewater sample collection, preparation of activated carbon from coconut fiber and rice husk, jar tests, filtration, and analysis of treated samples. Pollutant removal efficiency is measured based on reduction in solids, turbidity, and organic matter.

3. LITERATURE REVIEW

Numerous studies highlight the strong adsorption performance of activated carbon derived from agricultural wastes such as rice husk and coconut fiber. These adsorbents have proven effective in removing dyes, heavy metals, COD, TDS, and other pollutants. Their low cost, high porosity, and natural availability make them attractive for sustainable wastewater treatment.

4. CONCLUSION

The comprehensive review of previous studies clearly demonstrates that agricultural by-products such as rice husk, rice husk ash, coconut fiber, and coconut husk offer highly promising alternatives to commercial activated carbon for wastewater treatment. These materials exhibit strong adsorption capabilities due to their porous structure, high carbon content, and enhanced performance through chemical activation. Research consistently shows that these natural adsorbents can efficiently remove turbidity, TSS, TDS, COD, BOD, dyes, heavy metals, and nitrate from wastewater. Coconut-based activated carbon often shows superior performance in removing organic pollutants, while rice-husk-based activated carbon excels in heavy metal and nutrient removal. The effectiveness also increases with optimized dosage, particle size, and activation methods.

Overall, the review strongly supports the use of low-cost activated carbon produced from coconut fiber and rice husk as an environmentally sustainable and economically feasible solution for wastewater treatment. Their abundant availability, biodegradability, and cost-efficiency make them suitable for large-scale adoption, especially in developing countries. Combining these materials further enhances adsorption efficiency, proving beneficial for real-world wastewater purification systems.

5. FUTURE SCOPE

Future work may focus on optimizing chemical and thermal activation techniques to further enhance the porosity, surface area, and adsorption efficiency of coconut fiber and rice-husk-derived activated carbon. Advanced material characterization methods such as BET, FTIR, SEM, and XRD can help understand pollutant interaction mechanisms and guide the development of superior bio-adsorbents.

There is significant potential in developing hybrid and nano-enhanced adsorbents by combining these materials with metal oxides, polymers, or nano-composites for improved removal of emerging contaminants such as pharmaceuticals, microplastics, pesticides, and industrial chemicals. Pilot-scale studies and continuous column experiments should be conducted to evaluate long-term performance and regeneration capability under real wastewater conditions.

Furthermore, integrating these natural adsorbents into decentralized rural filtration units, household filters, and industrial wastewater treatment plants can improve water availability and reduce treatment costs. Life-cycle assessment (LCA) and cost-benefit analysis will help validate the economic and environmental feasibility of using these bio-adsorbents. Overall, coconut fiber and rice husk activated carbon have excellent potential to transform wastewater treatment into a sustainable and eco-friendly process.

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