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Treatment of Municipal Wastewater using Bio-Absorbents (Corn Cob)

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Abstract: *This Project report investigates the application of "Treatment of Municipal Wastewater Using Bio-Absorbents (Corn Cob)". Municipal wastewater contains pollutants such as organic matter, suspended solids, and heavy metals, posing environmental and health risks. This study investigates the use of corn cob-derived bio-adsorbents, an abundant agricultural waste, for eco-friendly and cost-effective wastewater treatment. Corn cobs were cleaned, dried, ground, and chemically treated to enhance adsorption properties. Batch experiments assessed pollutant removal efficiency under varying conditions of contact time, pH, and adsorbent dosage. Results show significant reduction of contaminants, demonstrating the effectiveness of corn cob bio-adsorbents. This approach provides a sustainable, low-cost solution for wastewater purification while valorizing agricultural residues*

Keywords: Municipal Wastewater, Bio-adsorbents, Corn Cob, Agricultural Waste, Wastewater Treatment, Eco-friendly Treatment, Low-cost Treatment

I. INTRODUCTION

Municipal wastewater is an unavoidable by-product of daily human activities. Water used for cooking, cleaning, bathing, washing clothes, and sanitation eventually becomes wastewater that carries organic matter, detergents, food residues, and microorganisms. When this wastewater is released into rivers or lakes without proper treatment, it creates serious environmental problems. One of the major concerns is the increase in Biochemical Oxygen Demand (BOD), which reduces the oxygen available in water bodies and harms fish and other aquatic life. Managing municipal wastewater properly is therefore essential for protecting both the environment and public health.

Conventional wastewater treatment systems such as aeration tanks, activated sludge processes, and chemical treatments are widely used to reduce pollution. While these methods are effective, they require large investments, continuous energy supply, and skilled operation. In many developing regions and rural areas, these requirements make conventional treatment systems difficult to implement and maintain. This situation highlights the need for simpler, affordable, and eco-friendly treatment alternatives.

In recent years, researchers have begun exploring the use of agricultural waste materials for wastewater treatment. These materials are naturally available, biodegradable, and cost-effective. One such material is corn cob, which is usually discarded after maize harvesting. Instead of being treated as waste, corn cob can be reused as a useful resource. Its porous and fibrous structure allows it to trap organic pollutants and provides a suitable surface for the growth of beneficial microorganisms that help break down organic matter in wastewater.

Using corn cob as a bio-absorbent offers several advantages. It helps reduce BOD through natural adsorption and biological activity while avoiding the use of harmful chemicals. At the same time, it promotes waste-to-resource utilization by converting agricultural residue into a valuable treatment material. Since corn cob can be used in its natural form with minimal processing, the method remains simple and economical.

This study aims to evaluate the effectiveness of untreated corn cob in reducing BOD levels in municipal wastewater. By adopting a natural and sustainable approach, the project demonstrates how simple materials can provide practical solutions to wastewater pollution, especially in areas with limited resources.

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II. LITERATURE SURVEY

Imran Ali et al. (2016): -

He carried out a study to explore how corn cobs, an agricultural waste product, can be turned into effective bio-adsorbents for cleaning simulated municipal wastewater. The research focused on finding eco-friendly and low-cost solutions for water purification, particularly for areas with limited resources. In their work, dried corn cobs were ground into a fine powder (0.5-1 mm) to increase surface area, and some samples were treated with mild acids or bases to improve their adsorption ability. Batch experiments were performed by varying conditions such as adsorbent dosage, pollutant concentration, contact time, pH, and temperature. The results showed that corn-cob-based adsorbents efficiently removed heavy metals and synthetic dyes from wastewater. Overall, the study highlighted that agricultural by-products like corn cobs can serve as sustainable, affordable, and effective materials for wastewater treatment, contributing to cleaner environments and better waste utilization.

Majumder, Muttepwar, and Naik wade (2019): -

Domestic wastewater treatment is essential for maintaining public health and environmental balance, yet conventional methods often demand high costs and infrastructure. Researchers have explored agricultural residues like corn cobs as sustainable alternatives due to their porous structure and natural adsorption capacity. Majumder, Muttepwar, and Naik wade (2019) reviewed the potential of corn cobs in treating household wastewater, emphasizing their ability to reduce organic impurities and suspended solids effectively.

Radhika et al. (2025): -

Heavy metal contamination in water, especially from ions like Fe (II) and Cr (VI), poses serious risks to ecosystems and human health. Traditional treatment methods often involve high costs and chemical usage, prompting researchers to explore natural, low-cost alternatives. Agricultural residues such as corn husks have gained attention due to their porous structure and functional groups that enable effective adsorption. Earlier studies demonstrated the potential of corn-based materials in removing dyes, oils, and heavy metals, highlighting their affordability compared to activated carbon. Radhika and colleagues (2025) advanced this research by focusing specifically on Fe (II) and Cr (VI) removal using biosorbents derived from corn husks.

Patil, Lalit Pramod, et al (2019): -

Sewage wastewater management is a critical challenge, especially in rapidly urbanizing regions where conventional treatment methods often prove costly and resource-intensive. Researchers have increasingly explored agricultural by-products as eco-friendly alternatives, with corn cobs gaining attention due to their porous structure and lignocellulosic composition. Prior studies demonstrated corn cob's ability to adsorb dyes, oils, and heavy metals, positioning it as a low-cost substitute for activated carbon. Patil, Lalit Pramod, and colleagues (2019) extended this line of inquiry by applying corn cobs to sewage wastewater treatment. Their findings revealed significant pollutant reduction, highlighting both environmental and economic benefits. By turning agricultural waste into a functional adsorbent, the study underscores the dual advantage of waste valorization and sustainable water management. This research contributes to the growing body of evidence that simple, natural materials can provide effective solutions to complex pollution problems, bridging laboratory innovation with practical community applications.

Sudhir, Shruti, and K. Prasanna (2023): -

Wastewater from automobile service stations is a growing environmental concern, as it often contains oil, grease, detergents, and heavy metals that are difficult to treat with conventional methods. Researchers have increasingly explored natural adsorbents as sustainable alternatives, with corn cob emerging as a promising option due to its porous structure and abundance as agricultural waste. Earlier studies demonstrated corn cob's ability to remove dyes and heavy metals from industrial effluents, highlighting its cost-effectiveness compared to activated carbon. Building on this foundation, Sudhir, Shruti, and Prasanna (2023) investigated its application specifically for automobile service station wastewater. Their findings showed that corn cob effectively reduced pollutants, offering a simple, eco-friendly, and

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affordable treatment solution. This work bridges laboratory research with practical environmental management, proving that waste materials can be repurposed to tackle pollution challenges.

III. MATERIALS AND METHOD

COLLECTION OF WASTE WATER SAMPLE
↓
COLLECTION OF BIO-ABSORBENT
↓
PERFORM PRELIMINARY ANALYSIS ON UNTREATED WASTE WATER SAMPLE
↓
PREPARATION OF BIO-ABSORBENT
↓
EXPERIMENTAL SETUP & CONDUCTION OF TEST
↓
PERFORM FINAL ANALYSIS ON TREATED WATER SAMPLE
↓
RESULTS
↓
CONCLUSION

COLLECTION OF WATER SAMPLE

Collecting a municipal water sample from a treatment plant is an important step to understand how clean and safe the water is for public use. The sample is usually taken from the inlet, where raw water from sources like reservoirs enters the plant. This water often contains mud, leaves, organic matter, and sometimes harmful microorganisms. To collect the sample, clean bottles are used, and the water is allowed to flow for a few minutes before filling. The bottles are labelled with details such as the date, time, and place of collection, then kept in a cool box and sent to the laboratory for testing. At the treatment plant, the municipal water goes through several stages before it becomes safe to drink. First, large particles are removed through screening. Then, chemicals are added in coagulation and flocculation to help small particles stick together and settle down. After that, the water passes through sedimentation and filtration to remove remaining impurities. Finally, disinfection (usually using chlorine or UV light) kills harmful germs. The clean water is then stored and distributed to homes and public places, ensuring a safe and healthy water supply for everyone.

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COLLECTION OF BIO ABSORBENT

Corn cobs, often discarded as agricultural waste, are quietly becoming eco-heroes in the world of bio-absorbents. These fibrous cores of maize are naturally porous, lightweight, and biodegradable making them ideal for soaking up liquids in a variety of settings. Think of them as nature's sponge, but with a much smaller environmental footprint. One of the biggest advantages of corn cob absorbents is their sustainability. They're renewable, compostable, and repurposed from a byproduct that would otherwise go to waste. In industries, they're used to clean up oil spills, chemical leaks, and even in metal finishing processes where gentle polishing is needed. At home, they can be found in pet litter, garden mulch, or even as carriers for fertilizers and pesticides. What makes them stand out is their balance of strength and softness they're tough enough to absorb oils and greases, yet gentle on surfaces. Plus, they're non-toxic and safe for use around animals and plants. For farmers, manufacturers, and eco-conscious consumers alike, corn cob bio-absorbents offer a smart, earth-friendly alternative to synthetic materials. It's a small shift with big impact turning humble harvest leftovers into powerful tools for a cleaner, greener world.

DESIGN OF FILTRATION SYSTEM TREATING OF MUNICIPAL WASTE WATER

WATER SAMPLE AFTER TREATING WITH BIO-ABSORBENT

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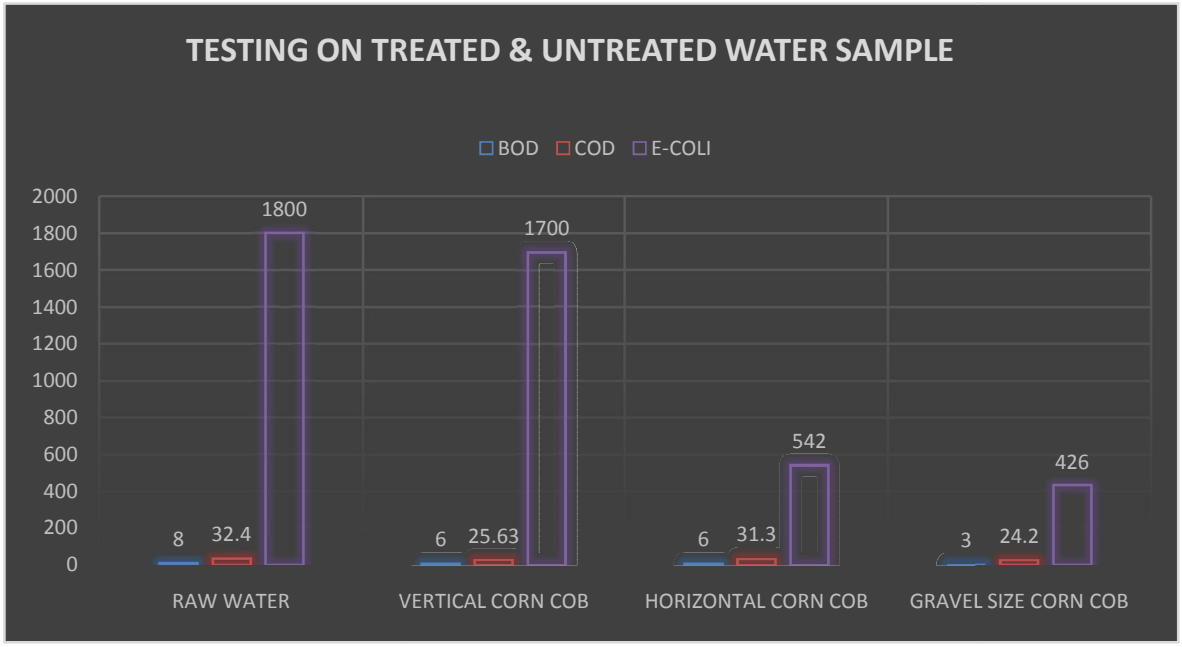
IV. RESULT AND DISCUSSION

SL. NO	TEST	RAW WATER	VERTICAL CORN COB (water)	HORIZONTAL CORN COB (water)	GRAVEL SIZE CORN COB (water)
1	Acidity	48 mg/l	57.2 mg/l	58.4 mg/l	46.4 mg/l
2	Alkalinity	368 mg/l	366.4 mg/l	386.8 mg/l	366.4 mg/l
3	Chlorides	350.0 mg/l	470.11 mg/l	416.30 mg/l	322.84 mg/l
4	Hardness	26.12 mg/l	61.04 mg/l	46.4 mg/l	24.4 mg/l
5	COD	32.4 mg/l	25.63 mg/l	31.3 mg/l	24.2 mg/l
6	BOD	8 mg/l	6 mg/l	6 mg/l	3 mg/l
7	E-Coli	>1600 MNP/100 ml	>1600 MNP/100 ml	542 MNP/100 ml	426 MNP/100 ml

Table 1: - TESTING ON TREATED & UNTREATED WATERSAMPLE



V. CONCLUSION

Corn cob filtration offers a sustainable, low-cost solution for municipal wastewater treatment. VERITCAL CORN COB (BOD = 6 mg/l; COD = 25.63 mg/l; E-Coli = >1600 MPN/100ml). HORIZONTAL CORN COB (BOD = 6 mg/l; COD = 31.3 mg/l; E-Coli = 542 MPN/100ml). GRAVEL SIZE CORN COB (BOD = 3 mg/l; COD = 24.2 mg/l; E-Coli = 426 MPN/100ml) Among the tested methods vertical, horizontal, and gravel-sized setups the gravel-sized corn cob showed the most effective results, significantly reducing BOD, COD, and E. coli levels. While acidity and hardness varied, the overall performance highlights corn cob's potential as a natural bio-adsorbent. This approach not only repurposes agricultural waste but also supports eco-friendly water purification in resource-limited communities. By turning waste into a tool for healing, corn cob filtration bridges environmental sustainability with practical innovation, making clean water more accessible and affordable for all.

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