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"REPLACING REVERSE OSMOSIS USING LOW COST ADSORBENTS"

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Abstract - *As we know that, surface water and ground water are polluted because of anthropogenic activity. Adequate Supply of fresh and clean drinking water is essential for all human beings on the earth, yet it has been observed that millions of people worldwide are still drinking water that is contaminated by bacteria, toxic chemicals and other pollutants. This work investigates the feasibility of replacing reverse osmosis (RO) with low-cost adsorbent through physico-chemical characteristics. This work suggests that adsorbent filtration offers a cost-effective alternative with comparable contaminant removal efficiency, providing valuable insights for sustainable water treatment solutions. We are using adsorbents i.e, Sugarcane bagasse, Walnut shells, Ricehusk, Orangepeel, Neem saw dust and investigating it's effectiveness and contaminant removal capacity. We have tested the basic parameters like P^H test, Alkalinity test, Chloride test, TDS test, Turbidity& Hardness test. Activated sugar cane bagasse and activated walnut shells have given better results. Sugarcane bagasse reduced hardness by 23.33% and TDS by 32% , where as Walnut shells reduced hardness by 16.67%. But both failed in chloride test as it is increased by 31.66% for Sugarcane bagasse and 25% for walnut shells. Neem saw dust gives poor results compared to all adsorbents.*

Key Words: TDS: Total dissolved solids, RO: Reverse osmosis

1. INTRODUCTION

Access to clean and safe drinking water remains a critical global challenge, particularly in regions with limited resources and infrastructure. Conventional water treatment methods, such as reverse osmosis (RO), while effective, often present barriers to widespread adoption due to their high costs and energy-intensive nature. In response to these challenges, there is growing interest in exploring alternative and sustainable water purification technologies that are both cost-effective and environmentally friendly.

One promising avenue for addressing these challenges lies in the utilization of low-cost adsorbents derived from natural or waste materials. Materials such as walnut shell, rice husk, sugarcane bagasse, orange peel, and neem wood possess inherent adsorptive properties that can effectively remove contaminants from water through physical or chemical interactions. These materials, often considered as agricultural or industrial byproducts, offer a renewable and readily available source of adsorbents that can be harnessed for water treatment applications.

This study aims to investigate the potential of utilizing walnut shell, rice husk, sugarcane bagasse, orange peel, and neem wood as low-cost adsorbents for water purification. Through a combination of laboratory experiments and economic assessments, we seek to evaluate the effectiveness, affordability, and scalability of these adsorbents in comparison to traditional water treatment methods such as reverse osmosis. By harnessing the natural adsorptive capabilities of these materials, we aim to contribute to the development of sustainable and accessible solutions for providing clean drinking water to communities worldwide.

1.1 Preparation of Zinc Chloride

Preparation of 0.1M zincs chloride solution:

Take properly weighed 13.63 gm of zinc chloride and dissolve in a minimum volume of 2M HCl, add 500 ml of distilled water and allow cooling and dissolving. Once it has completely dissolved, make up the volume to 1000 ml with water.

Preparation of 2M HCl:

Take 07.30 gm of concentrated hydrochloric acid in 1000 ml of distilled water.

1.2 Design of Membrane

- This membrane consists of PVC pipe, wire mesh, one inlet and one outlet.
- The diameter of wire mesh is 3.75cm and diameter of PVC pipe is 7.5cm and the length of the pipe is 65cm.
- The adsorbents of 5cm each are placed layer by layer in the wire mesh from bottom and each layer is divided by a 3cm layer of cotton.

2. RESULTS AND DISCUSSION

- Through the comprehensive evaluation of water quality parameters for Neem Saw Wood, Sugarcane Bagasse, Rice Husk, Orange Peeland Walnut, our study has yielded valuable insights into their potential as adsorbents for water treatment.
- Across the board, these natural materials have demonstrated effectiveness in reducing key contaminants such as Chloride, Hardness, Alkalinity and Total Dissolved Solids (TDS) to levels within acceptable ranges, as defined by established standards. Their performance underscores the

viability of employing low-cost adsorbents in water treatment processes, aligning with the principles of sustainability and environmental stewardship.

- However, certain considerations have emerged from our analysis. Neem Saw Wood exhibits efficacy in contaminant removal but falls short in maintaining an acceptable pH level, indicating a need for optimization in its application. Conversely, Sugarcane Bagasse stands out for its comprehensive performance, including satisfactory pH levels, positioning it as a promising candidate for immediate implementation in water treatment strategies.

Table -1: Column Study for the Treatment of Raw Water using Integrated Adsorbents

Wall Nut + Rice Husk + Neem Saw Dust + Orange Peel + Sugarcane bagasse			
Parameters	Raw water	Treated Water	Efficiency in %
Chloride	120 mg/l	204 mg/l	70
Hardness	300 mg/l	150 mg/l	50
Alkalinity	210 mg/l	270 mg/l	28.57
TDS	595 mg/l	300 mg/l	49.57
pH	7.47	7.3	2.27

From these results we can understand that the Chloride efficiency is 70%, Hardness efficiency is 50%, Alkalinity efficiency is 28.57%, TDS efficiency is 57.81%, pH efficiency is 2.27%. Chloride, Hardness, Alkalinity and pH are all in the acceptable limit as per IS Standards. But TDS not in the acceptable limit.

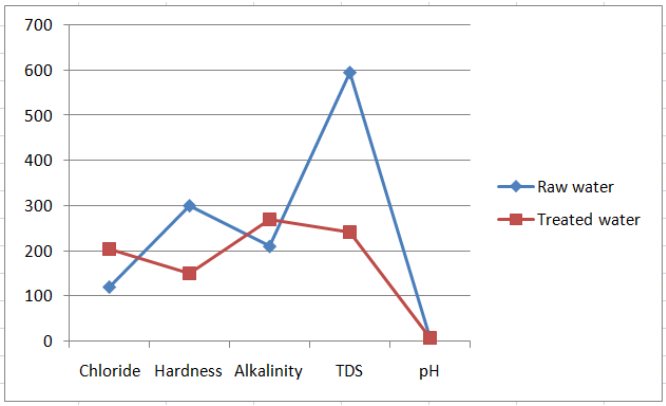

Chart -1: Parameters on Raw & Treated water

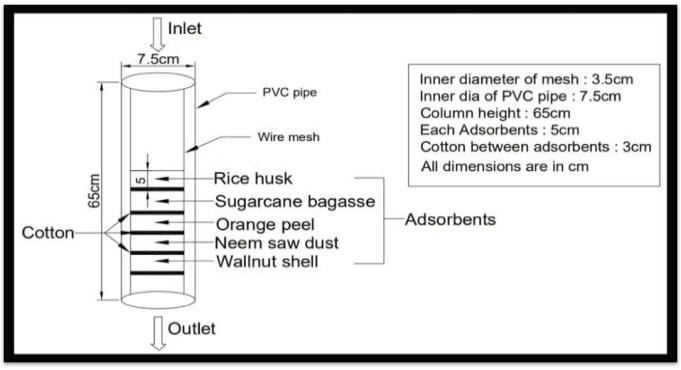

Fig -1: Line diagram of membrane

Fig -2: Model of membrane

This membrane consists of PVC pipe, wire mesh, one inlet and one outlet. The diameter of wire mesh is 3.75cm and diameter of PVC pipe is 7.5cm and the length of the pipe is 65cm. The adsorbents of 5cm each are placed layer by layer in the wire mesh from bottom and each layer is divided by a 3cm layer of cotton.

3. CONCLUSIONS

- The physico-chemical parameters analysed showed that the amount of chloride, alkalinity, and pH satisfied as perIS STD 10500-2012.
- Through the comprehensive evaluation of water quality parameters for Neem Saw Wood, Sugarcane Bagasse, Rice Husk, Orange Peeland Walnut, our study has yielded valuable insights into their potential as adsorbents for water treatment.
- Across the board, these natural materials have demonstrated effectiveness in reducing key contaminants such as Chloride, Hardness, Alkalinityand Total Dissolved Solids (TDS) to levels within acceptable ranges, as defined by established standards. Their performance underscores the viability of employing low-cost adsorbents in water treatment processes, aligning with the principles of sustainability and environmental stewardship.
- However, certain considerations have emerged from our analysis. Neem Saw Wood exhibits efficacy in contaminant removal but falls short in maintaining an acceptable pH level, indicating a need for optimization in its application. Conversely,

Sugarcane Bagasse stands out for its comprehensive performance, including satisfactory pH levels, positioning it as a promising candidate for immediate implementation in water treatment strategies.

- Moreover, Rice Husk, Orange Peeland Walnut demonstrate varying degrees of effectiveness in contaminant reduction, with each material presenting unique advantages and challenges. While Rice Husk and Walnut show notable efficiency in certain parameters, such as Chloride and Hardness, Orange Peel excels in Alkalinity reduction. However, all three materials require further optimization to address specific shortcomings, such as inconsistent pH levels and limited removal efficiency.
- Moving forward, our project will focus on refining the application methodologies of these low-cost adsorbents to maximize their efficiency across all parameters. By leveraging the strengths of each material and addressing their respective limitations, we aim to develop tailored solutions that offer sustainable, cost-effective alternatives for water treatment applications.

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