Evaluation Of Hurda Biochar For pH Correction In RO Waste Water And Domestic Tap Water

Prof. Jhaveri D.A.[1], Miss. Gurubai Jewargi[2], Miss. Shrutika Yazaral[3]
Miss. Pratima Birr[4], Miss. Janvi Boddu,[5], Miss. Kashamata Kurapati[6]
[1]Assist.Professor, Dept of Mechanical Engineering
[4, 5]Dept of Mechanical Engineering
[2, 3, 6]Dept of Civil Engineering
[1, 2, 3, 4, 5, 6] AGPIT,Solapur

Abstract- *Biochar was produced from hurda dry waste through high-temperature pyrolysis (600–700°C) in a furnace using an earthen pot, followed by sieving to a particle size of 300 µm. To examine its applicability in water treatment, 1% and 3% (w/w) biochar doses were mixed with RO wastewater and tap water, and pH changes were monitored over 16 days in the environmental laboratory. The biochar reduced the initial alkaline pH(9.0–9.5) to values between8.43and 8.89 during the first 12 days, showing its potential for improving water quality for irrigation or soil nutrient enrichment. A rise and instability in pH after day 16 indicate delayed release of soluble minerals or microbial activity, suggesting the need for controlled pre-treatment or shorter contact periods. The findings demonstrate that hurda-based biochar is an effective short-term pH-adjusting material.*

Keywords- School Fees Management, Database System, Automation, Web Application, Receipt Generation, Fee Tracking, Education Management System.

I. INTRODUCTION

Biochar has emerged as a multifunctional material, significant potential in water treatment, soil enhancement, and environmental remediation. Its high carbon content, porous structure, and presence of surface functional groups allow it to adsorb ions, buffer pH, and interact with dissolved constituents. The selection of feedstock and pyrolysis conditions strongly influence the quality and reactivity of biochar. Hurda dry waste, a common agro- residue, can be thermochemically converted into biochar through pyrolysis at elevated temperatures, providing an efficient method for waste valorization. Water sources such as RO reject water and domestic tap water often exhibit elevated pH due to dissolved salts, minerals, and treatment processes. Long-term use of highly alkaline water may negatively affect soil structure, nutrient availability, and crop growth. This study explores the ability of hurda-derived biochar (600–700°C, 300 µm) to stabilize and reduce the pH of alkaline waters. By examining the pH response over a 16-day period at 1% and 3% dosages, the research aims to understand both the short-term benefits and the long-term behavior of biochar-water interactions.

Biochar Preparation

Hurda dry waste was collected, cleaned, and air-dried to remove moisture. The material was placed in a mitti (earthen) pot and subjected to pyrolysis in a laboratory furnace at a temperature range of **600–700°C** under limited oxygen conditions. The heating was maintained until complete carbonization was achieved. After cooling to room temperature, the resulting biochar was manually crushed and sieved using a **300-micron (300 µm) mesh** to obtain uniformly sized particles suitable for water treatment studies.

Water Sample Collection

Two types of water samples were used:

- **RO reject water** collected from a domestic RO unit
- **Tap water** collected from the Environmental Engineering Laboratory at the Civil Engineering Department

Both samples were stored in clean, airtight plastic containers and used immediately for analysis to prevent chemical changes.

Biochar doses of **1%** and **3% (w/w)** were prepared by adding the required quantity of biochar into **glass containers** containing water samples:

- **1%sample:**1gbiochar +99gwater

.3%sample:3gbiochar+97gwater Separate setups were maintained for:

- ROwaterwith1%biochar
- ROwaterwith3%biochar
- Tapwaterwith1%biochar
- Tapwaterwith3%biochar
- **Controls** (RO and tap water without biochar) were kept for comparison

All containers were covered with breathable mesh lids to avoid contamination while allowing natural gas exchange.

Flow chart 1: Proposed plan

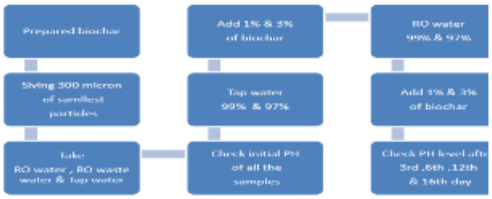

Fig1:pH meter to study the effect of biocharon

Fig 2:Water Samples different water type.

II. STUDIES AND FINDINGS

We selected three types of water for this experiment: tape water , RO water, and RO waste water. For each type of water, two samples were prepared. One sample contained 99% water, and the second sample contained 97% water.

Biochar was then added to the samples as follows

- 1%biocharwasaddedtothesamplescontaining99%water.
- 3%biocharwasaddedtothesamplescontaining97%water.

After adding biochar , all samples were mixed well. Finally, the pH levels of each samples were measured using pH

Flow chart 2: Preparation of biochar

EXPERIMENTAL SET-UP:

Without adding biochar
pHofROwastewater:9
pH of tap water: 9.50

- **3rdDayobservation:**

In our third day observation the pH level of both water sample increased their pH

Table1:Resultanalysisof3rdday

Concentration	Tap water	RO wastewater
1	9.15	8.51
3	8.55	8.43

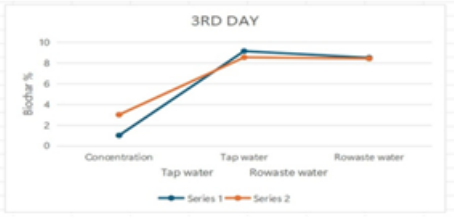

Fig3:3rdday pH improvement in tap ewater And RO waste water after biochar

- **6th Day observation:**

After 6th day, the biochar showed a significant increase in the pH level of the water, indicating very good results. This time

period can be considered optimal and can be used as a reference for You observed that on the 16th day, the pH level decreased.

Table2:Resultanalysisof6th day

Concentration	Tap water	RO waste water
1	9.15	8.79
3	8.70	8.47

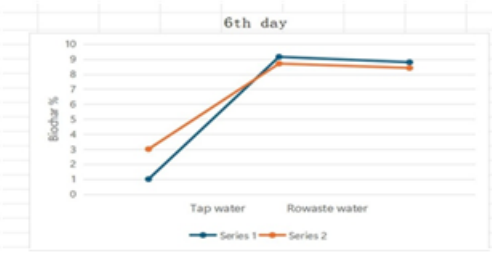

Fig4: Effect of biochar on pH of Twatter And RO waste water on 6th day

- **12thdayobservation:**

Heretheobservationislookslikeafter12thdaythepHlevelof these samples are decreased and also called as leaching of biochar.

Table3:Resultanalysisof12thday

Concentration	Tapwater	ROwastewater
1	8.89	13.7
3	8.70	14

Fig 5:Influence of bichar on pH of tap water and RO waste water on 12th day

- **16th day observation:**

From the beginning of the experiment up to the 12th day, the water samples (tap water and RO-waste water) showed a steady and continuous increase in pH level

Here the observation is looks like after12thday the pH level of these samples are decreased and also called as leaching of biochar.

This is not a failure — it is a valuable improvement in scientific understanding

Ç It shows that biochar effectiveness has a limit

Ç After a peak, the pH may start reducing as biochar becomes saturated

Ç It helps identify the exact duration for maximum treatment You observed that on the 16th day, the pH level decreased.

Table 4:Result analysis of 16th day

Concentration	Tap water	ROwastewater
1	9.8	9.5
3	12.2	9.18

Fig 5:Influence of bichar on pH of tap water and RO waste water on 12th day

Final Improved Research Insight:

Biochar increases the pH of tap water and RO-waste water up to the 12th day, with RO-waste water showing slightly better improvement. After the 12th day, a decrease in pH is observed on the 16th day, indicating that the optimal treatment period is 6–12 days. This helps identify the most effective and stable duration for using biochar in water purification.

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From the beginning of the experiment up to the 12th day, the water samples (tap water and RO-waste water) showed a steady and continuous increase in pH level after

III. CONCLUSION

The present investigation demonstrates that biochar produced from hurda dry waste under high-temperature pyrolysis (600–700°C) possesses promising pH-buffering properties when applied to alkaline water systems. Treatment with 1% and 3% biochar significantly reduced the pH of RO reject water and tap water from 9–9.5 to 8.43–8.89 within the first 12 days, confirming its suitability for improving water quality for soil nutrient enhancement and irrigation purposes.

Nevertheless, the pH instability noted on day 16 highlights the need for understanding long-term chemical and biological interactions within the biochar–water matrix. Overall, hurda-derived biochar exhibits strong potential as a sustainable, low- cost amendment for short-term pH correction, but further studies on long-term stability, ion exchange behavior, and microbial influences are recommended to optimize its practical application.

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