Production & Experiment Efficiency of Activated Carbon Using Peltophorum Seeds (COPPER POD)

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ABSTRACT

This study explores the eco-friendly and sustainable production of charcoal from Peltophorum seeds through controlled pyrolysis. It focuses on optimizing temperature, duration, and oxygen levels for efficient conversion, emphasizing the quality and yield of the resulting charcoal. The goal is to utilize Peltophorum seeds, considered agricultural waste, for value-added applications like charcoal production. This approach addresses environmental concerns related to waste management and contributes to the demand for renewable energy. The study includes an analysis of the produced charcoal, evaluating its calorific value, porosity, and potential applications in industries such as metallurgy, agriculture, and energy production. Additionally, environmental implications, such as reduced greenhouse gas emissions and potential carbon sequestration, are investigated. The economic feasibility and socio-environmental impacts of scaling up this charcoal production method are also briefly discussed.

Keywords

- Peltophorum Seeds
- Arsenic Metal
- Activated Carbon
- Carbonization
- Charcoal

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CHAPTER NO 01: - INTRODUCTION

1.1 INTRODUCTION

The history of charcoal production often involves various plant materials and has been practiced globally for centuries. Charcoal production historically evolved as a vital energy source for cooking, heating, and industrial processes. Different regions and cultures utilized locally available biomass, such as wood, peat, coconut shells, and other plant materials, for charcoal production. If there have been developments or historical records specific to Peltophorum seeds for charcoal making after January 2022, I recommend checking more recent sources, including scientific literature, agricultural records, or publications related to sustainable energy practices.

Additionally, local or regional histories and traditional knowledge sources might provide insights into any specific usage of Peltophorum seeds for charcoal in certain communities. Always consider the latest information and research for the most accurate and up-to-date details on specific topics, especially in rapidly evolving fields or industries.

Arsenic and other heavy metals occur naturally in geological structures or sometimes caused by mining, industrial and agricultural activities: -

[1] These chemicals can badly affect human health when they are consumed in large amount. The ground water at various locations in Bangladesh, States of West Bengal & Karnataka in India, has been noticed to be contaminated with Arsenic (As) in excess of its permissible value. Recently 14 out of 20 villages at Surpur taluq of Yadgir district, Karnataka state (India) has been found to be affected by Arsenic content.

The determination of Arsenic has been of importance to public health agencies for many years because of the toxicity of Arsenic compounds. Several incidents have demonstrated that Arsenic in water may be carcinogenic. Acute poisoning by Arsenic involves the central nervous system leading to coma and for doses of 70-80 mg to death. The gastro-intestinal tract, nervous system, the respiratory tract, and the skin can be severely affected. [2] It is recommended that, when water is found to contain Arsenic in excess of 0.01 mg/L (W.H.O), the water is considered to be unfit for drinking. Arsenic can be removed by many conventional and non-conventional methods.

Adsorption is used widely to remove Arsenic metal from water and industrial wastewater. Adsorption offers significant advantages like low cost, availability, profitability, easy of operation and efficiency, in comparison with conventional methods (such as membrane filtration or ion exchange) especially from economic and environmental points of view. There have been several studies of arsenic removal using activated carbon obtained from agricultural wastes like saw dust [1], jute stick [3] rice husk [4] etc.

Activated carbon made from easily available agricultural wastes can serve as an economically available alternative. As reported in a prior study saw dust was used as an adsorbent for arsenic removal and the effect of pH was studied. It was found that the optimum pH was 6.0. The adsorption properties of some other activated carbons obtained from jute stick using H_3PO_4

and rice husk have been studied [3]. It was found that the properties of the activated carbon in removing arsenic can be different for different materials used for preparing carbon and that the adsorption of anions was affected more compared to that of cations. In this research fruit of Peltophorum Pterocarpum (Copper pod) is used as an adsorbent, which is a waste material causing litter. So far there has been little study of arsenic adsorption using chemically activated carbon, despite the existence of many such investigations using activated carbon.
This study was to evaluate the preparation of chemically activated carbon using calcium chloride as an activating agent and detection of arsenic removal on prepared carbon as a function of contact time, adsorbent dosage and ph. Therefore, this study would contribute to the understanding of arsenic removal by adsorption on chemically activated carbon.

1.2 ORIGIN OF PROPOSAL: -

The chapter deals with the study efficiency of prepared carbon for arsenic removal from water. A. Effect of contact time B. Effect of carbon dosage C. Effect of Ph.

1.3 PURPOSE

The purpose of making charcoal from Peltophorum seeds can vary based on local needs and applications. Here are some potential purposes:

1) Energy Source

Charcoal derived from Peltophorum seeds can serve as a renewable energy source for cooking and heating. It releases energy when burned and can be used as an alternative to traditional fuels.

2) Cooking Fuel

In areas where traditional cooking fuels like wood are scarce, Peltophorum seed charcoal can be used as a sustainable fuel for cooking stoves. It provides a cleaner-burning option compared to some other biomass fuels.

3) Industrial purposes

It is use for purification and removal of harmful metals from industrial waste water for example lead, zinc, Arsenic which can be hazardous to human health and can also cause water pollution.

4) Environmental Benefits

Charcoal production from Peltophorum seeds might be promoted for its potential environmental benefits, including reduced deforestation if it serves as an alternative to traditional wood charcoal. It is a replacement of wood charcoal.

5) Waste Utilization

If Peltophorum seeds are a byproduct of another industry, making charcoal from these seeds could be a way to utilize waste material, contributing to a more sustainable and efficient production process.

1.4 OBJECTIVE: -

1. To study the physical and chemical properties of the prepared activated carbon.
2. To determine the efficiency of the prepared activated carbon.
3. Economical way to remove heavy metals from industrial waste water.
4. To arrive at the low-cost adsorbent for removal of heavy metal i.e., Arsenic metal.

1.5 PROPERTIES

Charcoal made from Peltophorum seeds, like other types of charcoal, is known for its porous nature, which provides several properties

High Porosity: -Charcoal from Peltophorum seeds typically has a high porosity, making it effective for adsorption of gases and impurities.

Low Ash Content: - It often has low ash content, indicating minimal impurities and a cleaner burning process.

Absorbent Properties: - Charcoal made from these seeds may exhibit absorbent properties, making it suitable for various applications, such as water purification or air filtration.

Renewable Source: - Using Peltophorum seeds for charcoal production can be considered environmentally friendly, as it comes from a renewable plant source.

Energy Efficiency: - Charcoal derived from Peltophorum seeds can be efficient as a fuel source, providing a steady and prolonged heat output.

1.6 SCOPE OF PROJECT: -

1. Seeds of Gulmohar (Royal Poinancios) can also be used for chemically activation to prepare chemically activated carbon.
2. Experiment can also be conducted with adsorbent of different particle size so as to choose the best sized adsorbent.
3. Pilot plant study may be tried using adsorbent.
4. Detailed study may be carried out for disposal of used adsorbent.

CHAPTER NO 02: -LITERATURE REVIEW

Sr No.	Author Name	Year	Content
1	ARUN KUMAR, DINESH PANDEY, RATNESH ANAND, NANDLAL CHAUDHARY	2011	Arsenic occurrence in the aquatic environment, its toxicity especially towards the health hazards are an established fact. Although it has a glorious history especially in the field of science, technology and medicine field, still its notoriety in the form of slow poison is a worldwide concerned today. Arsenic removals from the aquatic environment either from various waste bodies or from ground water of the into-Nepal boarder include various technologies including several comprehensive waste treatment strategies (Nurul et al., 2006). Most of these methods require high capital cost, skilled supervision, post expenditure and removal of waste toxic byproducts. Increased awareness on the toxicity of metal including arsenic prompted the authority concern the implementation of strict regulation for its disposal causing traditional treatment processes such as ion exchange reverse osmosis or membrane system etc are now becoming component in integrated systems that produce effluent of better quality while allowing for the recovery and reuse of metal (Brierly,1990). Immobilized chelation process for the removal of toxic arsenic has become an important option in the integrated approach to aqueous waste treatment. This process incorporates the principle of metal coordination to traditional ion-exchange technology thus effecting major changes in the application of the adsorbents (Hudson, 1986). In an increasing search for low-cost adsorbents various substances such as ablecmoschusesculentus saw dust tea leaves, fly ash has been reported. Now day arsenic has received a great deal of attention as it is one of the worst contaminated pollutants which can cause considerable damage to human and aquatic life even at trace level. Dangerous arsenic concentration in aquatic medium is

			now a worldwide problem. High arsenic concentrations have been reported recently from various countries including developed country like USA, China. India is not far behind and apart from Bangladesh which tops the list of effected countries its one state which is just bordering Bangladesh, i.e., west Bengal. Arsenic is ubiquitous pollutant and is a worldwide problem. Adsorption is evolving as a frontline of Défense. Selective adsorption utilizing biological materials, mineral oxides activated carbons etc has generated increasing excitement.
2	M.N. Amin, Kaneco, T. Kitagawa, A. Begum, H. Katsumata, T. Suzuki, K. Ohta	2006	A number of treatment techniques such as adsorption, cation exchange, lime softening, reverse osmosis, coagulation and precipitation have been developed for arsenic decontamination. Adsorption has been paid more at-tension due to its simplicity, cost effectiveness, eco-friendly, and availability of wide range of adsorbents [5] [6]. Rice husk (RH) is a well-known low-cost adsorbent for removal processes. It contains abundant floristic fiber, protein and functional groups such as carboxyl, hydroxyl and amidogen which make adsorption process possible [7] [8]. The direct use of rice husk for arsenic removal has been reported in the recent studies [5] [9] [10]. However, the low removal efficiency of reported methods limited the practical application. Recent research efforts have been focused on the modification of RH surface in order to improve the arsenic adsorption efficiency. Mondol et al. [11] examined the removal of trivalent arsenic (As (III)) from contaminated water by $CaCl_2$-impregnated rice husk car-bon. Agrafioti et al. [12] reported the arsenic removal from water using biochar derived from rice husk. In the study, the removal of only as(V) was tested, and the maximum adsorption efficiency was 2.59 µg/g, which was very poor compared with other conventional techniques. Moreover, relatively high temperature (300˚C) was used for preparing biochar. Therefore,

			there is little information on the as (III) removal in water with rice husk heated at relatively low temperature
3	M Israt Jahan, M Abdul Motin, M Moniuzzan and M Asadullah	2008	Arsenic contamination of underground water has createated a big public health problem in many countries. The arsenic concentration of 0.05 mg/L in drinking water has been set by World Health Organization (WHO) as the upper permissible limit for Bangladesh. The higher concentrations of arsenic than the upper permissible limit can cause its deposition in human body and lead to serious human health problems. It takes about 8-14 years for symptoms to appear depending on the person1.Therefore, the arsenic level in drinking water must be lowered than that of WHO recommended level. It is only possible by removing arsenic from water. Different attempts have been made to remove arsenic from water. They are: coagulation/precipitation2,3, sedimentation, filtration4, adsorption5, magnetic separation6, ionexchange7, membrane/reverse osmosis8 etc. Metal ion removal from water by activated carbon is based on adsorption process on the solid liquid interface9,10. High surface area of activated carbon with optimum micropore size is thus required for efficient adsorption of arsenic species from water. In addition, the ease of the production and yield of the activated carbon also play important roles for economic separation of arsenic from water. These lead to optimise the production conditions and characterization of activated carbon. To meet the requirement for effective separation of arsenic from water, the aim of the present work is to develop suitable adsorbent from agricultural residues such as jute stick, which is available in many countries such as India, Bangladesh etc. In this work the high surface area activated carbon was targeted to be used as an arsenic removing material from drinking water. The jute stick was considered as raw material for high surface area activated carbon production. The activated carbon was

			produced by chemical activation process using H3PO4 as an activating agent. Before using the activated carbon for arsenic separation from water, it was characterized by measuring the specific surface area, iodine number and methylene blue number.
4	Shashikant.R. Mise, Indrale Divyarani	2013	Arsenic and other heavy metals occur naturally in geological structures or sometimes caused by mining, industrial and agricultural activities [1]. These chemicals can badly affect human health when they are consumed in large amount. The ground water at various locations in Bangladesh, States of West Bengal & Karnataka in India, has been noticed to be contaminated with Arsenic (As) in excess of its permissible value. Recently 14 out of 20 villages at Surpur taluq of Yadgir district, Karnataka state (India) has been found to be affected by Arsenic content. The determination of Arsenic has been of importance to public health agencies for many years because of the toxicity of Arsenic compounds. Several incidents have demonstrated that Arsenic in water may be carcinogenic. Acute poisoning by Arsenic involves the central nervous system leading to coma and for doses of 70-80 mg to death. The gastro-intestinal tract, nervous system, the respiratory tract, and the skin can be severely affected [2]. It is recommended that, when water is found to contain Arsenic in excess of 0.01 mg/L (W.H.O), the water is considered to be unfit for drinking. Arsenic can be removed by many conventional and non-conventional methods. Adsorption is used widely to remove Arsenic metal from water and industrial wastewater. Adsorption offers significant advantages like low cost, availability, profitability, easy of operation and efficiency, in comparison with conventional methods (such as membrane filtration or ion exchange) especially from economic and environmental points of view. There have been several studies of arsenic removal using activated carbon obtained from agricultural wastes like saw dust [1], jute stick [3], rice husk [4] etc. Activated carbon made from easily available agricultural wastes can serve as an economically available alternative. As reported in a prior study saw dust was used as an adsorbent for arsenic removal and the effect of pH was studied. It was found that the optimum pH was 6.0. The adsorption properties of some other activated

			carbons obtained from jute stick using H3PO4 and rice husk have been studied [3]. It was found that the properties of the activated carbon in removing arsenic can be different for different materials used for preparing carbon and that the adsorption of anions was affected more compared to that of cations. In this research fruit of Peltophorum Pterocarpum (Copper pod) is used as an adsorbent, which is a waste material causing litter. So far there has been little study of arsenic adsorption using chemically activated carbon, despite the existence of many such investigations using activated carbon. This study was to evaluate the preparation of chemically activated carbon using calcium chloride as an activating agent and detection of arsenic removal on prepared carbon as a function of contact time, adsorbent dosage and ph. Therefore, this study would contribute to the understanding of arsenic removal by adsorption on chemically activated carbon.
5	Le Zeng	2004	arsenic is one of the most toxic elements occurring naturally in the environment. In natural water, arsenic is primarily present in inorganic forms and the dominant arsenic species is a function of pH and the redox potential of water. Arsenate—As(V)—is the major arsenic species in surface water and normally exists in four forms in aqueous solutions: H3AsO4, H2AsO4 -, HAsO4 2- and AsO4 3- over the pH range of 5 to 12. Arsenite—As (III)—is favoured under reducing conditions, and thus is the dominant arsenic in groundwater. As (III) is present mainly as H3AsO3 over the pH range of 2 to 9. As (III) is more toxic than as(V) (Ferguson and Davis 1972; Cullen and Reimer 1989; Korte and Fernando 1991). Arsenic can be removed by adsorption on some metal oxides. Iron (III) oxides are the ones broadly investigated, presumably due to their abundant existence in the natural aquatic system and their larger adsorptive capacity of arsenic. There have been several studies of arsenic adsorption capacities, kinetics and isotherms using single iron(III) oxide in the forms of in situ prepared suspensions and iron oxide-coated sand, mostly amorphous hydrous ferric oxide (FeOOH) or poorly crystalline hydrous ferric oxide (ferrihydrite) (Pierce and Moore 1982; Hsia et al. 1994; Wilkie and Hering 1996; Driehaus et al. 1998; Fuller et al. 1993; Raven et al. 1998; Jain and Loeppert 2000),

			goethite (α-FeOOH) (Sun and Doner 1998), other crystalline hydrous ferric oxide (Manna et al. 2003) and iron oxide-coated sand (Thirunavukkarasu et al. 2003; Joshi and Chaudhuri 1996). However, most iron (III) oxides are available only as fine powders or are generated in situ as gels or suspensions in an aqueous solution. These forms of iron (III) oxides retain their strong affinities to as(V) and as (III), but are limited to reactor configurations incorporating large sedimentation and filtration units, which cause difficulty in solid/liquid separation (Lo and Chen 1997). Furthermore, iron (III) oxide alone is not suitable as a filter medium du

CHAPTER NO 03: -METHODOLOGY

Materials

1. Peltophorum seeds
2. A container (like a metal can with a lid)
3. Heat source (e.g., a campfire or a controlled oven)
4. A source of airflow (ventilation system or a hole in the container)

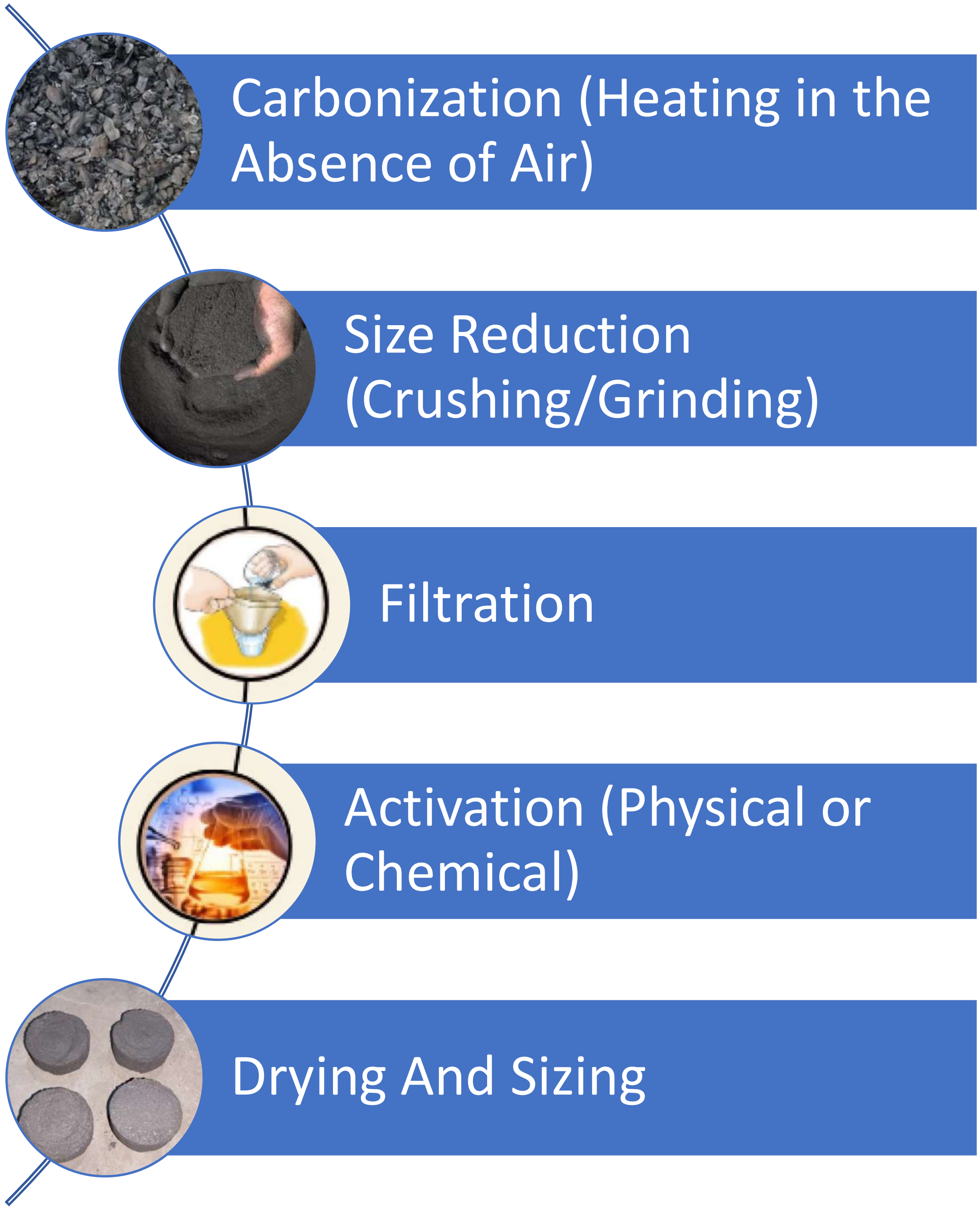
Methodology

1. Carbonization
2. Size reduction
3. Filtration
4. Activation
5. Drying and sizing

The Peltophorum seeds are collected and cleaned to remove impurities and moisture, ensuring a more efficient carbonization process. The cleaned seeds are subjected to elevated temperatures in an oxygen-limited environment. This process breaks down the organic compounds within the seeds, releasing volatile substances like gases and tar while leaving behind the carbon-rich residue, which is charcoal.

Controlling the temperature and duration of the pyrolysis process is crucial. Higher temperatures can yield charcoal faster but may affect its quality. The duration of the heating also influences the final product's properties. The charcoal is cooled slowly to prevent combustion.

Flow Chart


Carbonization (Heating in the Absence of Air)
Size Reduction (Crushing/Grinding)
Filtration
Activation (Physical or Chemical)
Drying And Sizing

1) Carbonization (Heating in the Absence of Air)

Carbonization in charcoal making involves heating biomass in the absence of air to convert it into charcoal. For peltophorum seeds, the process typically includes drying the seeds, placing them in a low-oxygen environment, and gradually raising the temperature. This drives off volatile compounds, leaving behind carbonized material. The resulting charcoal can be used for cooking or as a soil amendment. It's essential to control the temperature and airflow during carbonization to achieve desired charcoal properties.

2) **<u>Size Reduction (Crushing/Grinding)</u>**

Crushing and grinding peltophorum seeds is a common initial step in charcoal making. The process helps break down the seeds, making it easier to extract charcoal during the subsequent stages. Grinding increases the surface area, aiding in efficient carbonization when the seeds are subjected to heat. Remember to follow proper safety precautions and consider the moisture content of the seeds for optimal results in the charcoal-making process.

3) Filtration

Filtration plays a role in charcoal making from peltophorum seeds, primarily during the liquid phase of the process. After crushing and grinding, some methods involve soaking the seeds or extracting liquids. Filtration helps separate these liquids from the solid residue, ensuring a cleaner and more efficient carbonization process. It's essential to choose appropriate filtration materials to capture impurities and allow the desired liquids to pass through.

4) Activation (Physical or Chemical)

Physical activation is a crucial step in charcoal making from peltophorum seeds. This process involves exposing the crushed and ground seeds to high temperatures in the presence of an activating agent, such as steam or carbon dioxide. This activation step creates a porous structure in the charcoal, increasing its surface area and enhancing its adsorption properties. The porous nature of the activated charcoal makes it effective for various applications, such as water purification or air filtration.

5) Drying And Sizing

After the process of filtration, the powdered form of charcoal is compressed and moulded in a block form with the help of moulds. This moulded form of charcoal is easy to use and accessible.

CHAPTER NO 04: -RESULT AND DISCUSSION

The obtained results indicate the feasibility of utilizing Peltophorum seeds for charcoal production and their subsequent potential applications. The yield of charcoal, though variable, aligns with expectations from similar agricultural waste sources, showing promise for scalability.

The variability in yield and physical properties may be attributed to factors like seed quality, carbonization temperature, and duration. Optimizing these parameters could potentially enhance yield and standardize the charcoal's properties for consistent quality.

the results demonstrate the viability of Peltophorum seeds as a renewable source for charcoal production, offering a sustainable solution to agricultural waste while yielding a resourceful material with diverse industrial and environmental applications.

CHAPTER NO 05: -CONCLUSION

The carbonization process effectively converted Peltophorum seeds into charcoal, yielding a product with favorable physical and chemical attributes. The obtained charcoal demonstrated a porous structure, varying in color and exhibiting high carbon content, making it suitable for diverse applications requiring carbon-rich materials.

Its potential in areas like water purification, air filtration, and even in industrial processes involving adsorption emerged as a notable outcome.

In conclusion, the utilization of Peltophorum seeds for charcoal production presents a promising avenue for sustainable resource management. Further research and development in refining production processes and exploring potential applications can harness the full potential of Peltophorum seed-based charcoal, contributing to both environmental conservation and industrial innovation

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