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PEATKOL Dots: A Sustainable Substitute for Charcoal Made from Carbonized Coir Pith

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Abstract **- Biomass briquettes, particularly bio charcoal briquettes derived from coir pith, are emerging as sustainable and renewable alternatives to traditional coal and charcoal. This research paper investigates the development and potential of PEATKOL dots, a novel sustainable alternative to charcoal. The study explores the production process of these dots from carbonized coirpith, a readily available agricultural coconut product. The production process involves charcoal-making from coir pith, followed by briquette formation using a C 45 steel die. The composition of the briquette mixture, including charcoal particles, binder, and accelerant, was optimized to achieve the highest calorific value. The study also evaluated the flammable properties of the briquettes, including burning rates and ignition time. Proximate analysis was conducted to determine key parameters such as moisture content, volatile matter, ash content, calorific value, fixed carbon, and sulphur content. Results indicate that the selected species of charcoal briquettes exhibit favourable fuel characteristics, complying with international standards. The paper also assesses the physical and chemical properties of PEATKOL dots, comparing them to traditional charcoal.**

Keywords **-** ***Biomass, Briquettes, Peatkol, Carbonisation, Analysis.***

I. INTRODUCTION

Energy is a fundamental element for sustaining human life and plays a crucial role in the economic, social, and environmental development of society. As the world progresses, the energy sector assumes strategic importance, with an increasing need to conserve energy resources. The sources of energy can broadly be categorized into renewable and non-renewable sources. While non-renewable sources such as gasoline, coal, kerosene, and diesel have been significant contributors to energy needs, they face the challenge of being finite and non-replenishable.

In contrast, renewable energy sources have garnered attention for their numerous advantages, especially in terms of environmental impact. These sources produce minimal CO2 emissions and other harmful gases, making them more sustainable for human health and mitigating climate change. Among renewable energy options, biobriquettes have emerged as a promising choice for cooking fuels due to their widespread availability and potential for densified bioenergy production processes. However, certain biomass materials, such as crop residues, have been considered inadequate as efficient fuels due to factors like low density, fluctuating power output during combustion, and difficulty in handling and transportation.

To address these challenges and unlock the full potential of biomass as an alternative energy source, research has focused on converting biomass into compact forms that are easier to handle and utilize. The briquette method has proven to be an effective means of transforming raw biomass materials into high-calorific-value solid fuels that can compete with conventional options. In this regard, utilizing biomass resources like wood waste, coconut shells, coir pith, and livestock manure holds great promise for sustainable energy production.

In pursuit of this sustainable energy vision, the development of PEATKOL offers an innovative solution. PEATKOL, derived from carbonized coir pith, presents an eco-friendly and renewable alternative to charcoal. This research aims to explore the characteristics and potential of bio charcoal briquettes made from coir pith as a cleaner and more sustainable substitute for traditional charcoal. By utilizing locally available biomass feedstocks and employing efficient briquetting technology, PEATKOL aims to improve the calorific value, bulk density, and handling techniques for such biomasses. Through this development, PEATKOL seeks to contribute significantly to achieving sustainable growth and development, enhancing economic opportunities, and promoting environmental preservation.

Biomass, a diverse array of carbon-based complex polymers, consists of organic molecules comprising hydrogen, oxygen, and other elements in small quantities. Bio-briquettes, compacted combustible materials derived from biomass, have emerged as a promising form of fuel for heating and cooking in both industrial and household settings. The adoption of bio-

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briquettes presents an opportunity to address global and local energy challenges with clean, sustainable, and environmentally friendly resources. This technology not only fosters environmental and economic sustainability but also holds the potential to bring about social and political stability, signifying a true path towards long-term sustainability.

Residual lignocellulosic biomass, however, faces limitations in its energy utilization due to its low density. To overcome this challenge, densification techniques have been employed to produce products like briquettes and pellets, which offer additional advantages such as increased calorific value per volume, reduced transportation costs, and improved stability during storage, minimizing losses through degradation.

Bio-briquettes, a form of charcoal derived from various biomass materials such as wood, twigs, leaves, and agricultural waste, possess a high calorific value and long burning duration. Factors influencing the nature of bio-briquettes include the specific gravity of charcoal particles, particle fineness, carbonization temperature, and compaction pressure. A well-made bio-briquette exhibits a smooth surface and does not leave black marks on the hand, meeting essential criteria for ease of ignition, smokeless combustion, non-toxic gas emissions, and resistance to mould during storage.

While previous studies have largely focused on unprocessed biomass for briquette production, there remains a lack of information on briquettes made from processed biomass. This study aims to bridge that gap by exploring the potential of coir pith as a viable source for bio-briquette production, thereby highlighting proper technology for the sustainable production of BBQ charcoal, which is environmentally beneficial.

A. Coirpith

Coir pith, a product of coir fiber extraction industries, is considered to be an ideal product for agricultural applications. However, its sponge-like structure contributes to water retention and improved aeration in the root zone of crops, enhancing soil properties. While coir pith is not conventionally considered an ideal carbon source for agricultural use due to its wide carbon-nitrogen ratio and lower biodegradability, its transformation into bio-briquettes presents a unique opportunity to harness its potential for sustainable energy production.

By developing coir pith bio-briquettes, we seek to create a cleaner and greener energy solution that contributes to the betterment of the planet. This research endeavors to unlock the full potential of coir pith and demonstrate its significance in the pursuit of renewable and environmentally friendly energy sources.

B. Objective

The primary objective of our present invention is to devise a method for producing energy-efficient bio fuels in the form of briquettes, utilizing readily available biomass like coir pith. By employing this method, we aim to create a sustainable and renewable energy source that can effectively replace traditional fossil fuels for heating and cooking purposes.

Our invention also aims to formulate bio-briquettes with high calorific value and fixed carbon content. By optimizing the composition and processing of the briquettes, we seek to enhance their energy output and ensure a longer burning duration, thus making them a more viable and effective fuel source.

Another crucial objective of our present invention is to make efficient use of abundant and cost-effective raw materials, particularly biomass like coir pith. By harnessing the potential of such readily available resources, we strive to contribute to sustainable energy production and reduce dependence on non-renewable energy sources.

An additional objective of our current invention is to formulate a specific combination of coir pith and other materials that effectively reduces smokiness during briquette combustion while minimizing energy loss. This optimization ensures a cleaner burning process, making the bio-briquettes more environmentally friendly and efficient.

By achieving these objectives, our present invention aims to provide an innovative and sustainable solution for the production of bio-briquettes using coir pith. The resulting bio-fuel will contribute to a cleaner and greener energy future, promoting environmental conservation and sustainable development.

II. MATERIALS AND METHODS

The research experiment was conducted in four distinct phases as outlined below:

A. *Sterilization and Carbonization of Coir Pith*

The biomass raw material used in the study was sun-dried raw coir pith. To ensure decontamination, the coir pith underwent sterilization at an optimized temperature and duration. Subsequently, carbonization of the coir pith was carried out at the determined optimum temperature and duration to produce charcoal.

B. *Preparation of Coir Pith-Binder with Different ratios of Charcoal/Binder/Accelerant*

For the preparation of bio-briquettes, a coir pith-binder mixture was created using various charcoal/binder/accelerant ratios. Food-grade binder served as the binding agent during the experimentation. The binder and accelerant were mixed manually with the prepared charcoal powder at concentrations of 8 % and 4%, respectively. The prepared mixtures were then proportionally combined to form the briquette composition.

C. *Densification/Briquetting*

The densification process involved forming the briquettes using a manual press. C45 steel die was utilized to apply pressure during the compaction of the biomass, resulting in the desired briquette shape and density.

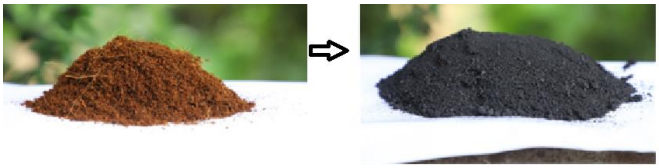

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FIG.1-Process of Making Coir pith to Petkaol Dots

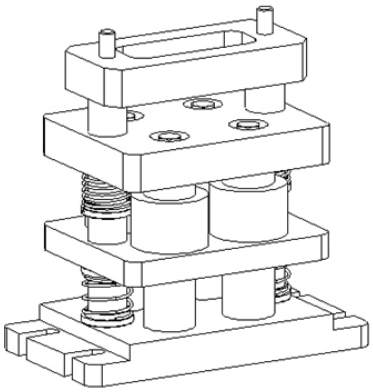

FIG.2-C45 Die used to densify the raw material

D. Composition of Briquette Mixture

The composition of the briquette mixture in our research involved 88% sterilized charcoal particles, 8% binder, and 4% accelerant, all mixed in hot water. The proportions were optimized to attain the desired characteristics of the briquettes. Altering the binder to charcoal ratio was found to impact the quality attributes of the briquettes.

Furthermore, during the process, it was ensured that the densified biomass briquettes (DBB) contained 20-25% moisture content (wt.). To achieve this, a natural drying process was employed until the moisture content of the DBB reached a range of 12-15%.

The experiment was conducted under controlled conditions, with meticulous attention given to each phase to achieve consistent and reliable results. By following this well-structured methodology, we aimed to develop an energy-efficient and environmentally friendly bio-fuel source in the form of bio-briquettes, utilizing coir pith as the primary biomass material.

III. RESULT AND DISCUSSION

The research conducted comprehensive tests on charcoal briquettes made from coir pith to assess their flammable characteristics, burning rates, and ignition time. Proximate analysis was also carried out to determine essential parameters such as moisture content (MC), volatile matter (VM), ash content (AC), calorific value (CV), fixed carbon (FC), and sulfur content (SC). The findings are presented and discussed below:

A. Moisture Content (MC)

In one embodiment of our current invention, the minimum moisture content recorded in the coir pith charcoal briquettes was 3.95%. This low moisture content indicates efficient drying during the production process, enhancing the combustion efficiency of the briquettes.

B. Volatile Matter (VM)

The least amount of volatile matter, 16.43%, was observed in the biomass briquettes. A low VM content signifies reduced emissions of volatile gases during combustion, contributing to a cleaner burning process.

C. Calorific Value (CV)

The maximum calorific value was recorded in Coir pith charcoal Densified Biomass Briquette (DBB) with a value of 5172 k.cals/kg or Deleted. A higher CV indicates a greater energy content, making these briquettes an efficient and potent fuel source.

D. Fixed Carbon (FC)

The coir pith charcoal briquettes exhibited a high level of fixed carbon, further contributing to their energy efficiency. Increased FC content suggests enhanced stability and longer burning duration during combustion.

E. Sulphur Content (SC)

The sulphur content in the bio-briquettes was found to be low, aligning with international standards. Reduced sulphur content implies less pollution and environmental impact during combustion.

The ignition time and burning results of coir pith charcoal, as per one embodiment of our invention, were analysed at different densities. The tabulated data in Table 1 and the graphical representation in Fig. 3 illustrate that an increase in density leads to an increase in burning time up to a certain point. The ignition time demonstrated a direct proportionality with density up to 0.295g/cm3.

Diameter (cm)	Thickness (cm)	Volume (cm^3)	Weight (g)	Density (g/ cm^3)	Compression Ratio	Ignition time (s)	Burning time (m)
3.6	3.7	37.64	6.2	0.165	1.6	9	42
3.6	3.5	35.61	6.6	0.185	1.7	10	45
3.6	2.9	29.50	6.3	0.214	2.0	14	51
3.6	2.3	23.40	6.5	0.278	2.6	15	59
3.6	2.2	22.38	6.6	0.295	2.7	18	69
3.6	1.8	18.31	6.2	0.339	3.3	20	68

TABLE.1. Physical Parameters of Peatkol Dots

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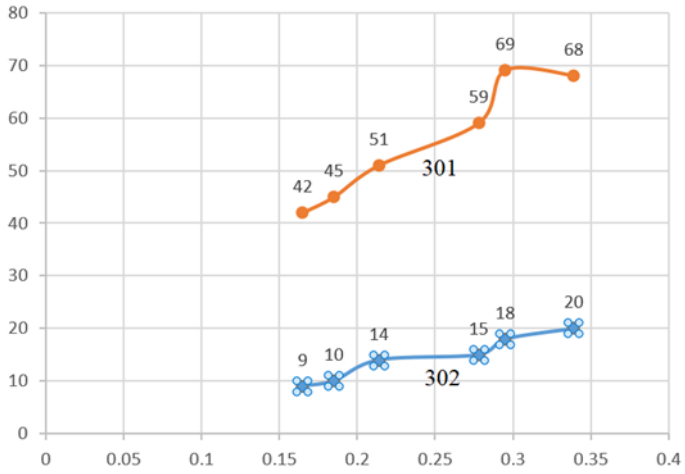

FIG.3. Graphical representation of Density (X-axis) to Burning Time and Ignition Time (Y-axis)

Overall, the results indicate that the coir pith charcoal briquettes, developed in accordance with one embodiment of our invention, exhibit favorable fuel characteristics, meeting international standards for quality. These briquettes possess higher calorific value, lower moisture content, increased fixed carbon content, and reduced sulfur content, making them a viable and sustainable substitute for traditional charcoal and fossil fuels.

The production and processing of bio-briquettes from coir pith showcases the potential of appropriate technology in generating sustainable BBQ charcoal, contributing to a greener and environmentally conscious planet. Through this research, we have demonstrated the feasibility of utilizing coir pith as a valuable biomass resource for bio-briquette production, promoting energy efficiency and eco-friendly practices.

IV. APPLICATIONS

The application of PEATKOL dots as a substitute for charcoal and incense purposes offers numerous benefits, ranging from environmental sustainability to improved user experience. PEATKOL dots, made from carbonized coir pith, present an innovative and eco-friendly solution that can effectively replace traditional charcoal and incense. Here are some key applications of PEATKOL dots:

A. Cooking and Heating Fuel:

PEATKOL dots can be used as an alternative cooking and heating fuel in households and commercial settings. Their high calorific value and efficient burning properties make them an ideal choice for cooking and heating reduces reliance on charcoal and firewood, leading to a significant reduction in deforestation and carbon emissions.

B. Barbecues and Grilling:

PEATKOL dots are suitable for barbecues and grilling purposes, providing a smokeless and odorless cooking experience. They produce a consistent and steady heat, ensuring even cooking and enhancing the flavor of the food. Their easy-to-use nature makes them convenient for outdoor cooking activities.

C. Incense and Aromatherapy:

PEATKOL dots can be utilized as a sustainable and natural incense material. When burned, they release a pleasant and soothing aroma, making them ideal for aromatherapy and creating a relaxing ambiance in homes and meditation spaces. The absence of harmful chemicals ensures a healthier atmosphere.

V. CONCLUSION

The research on the development of PEATKOL Dots using coir pith as a biomass source has yielded promising results. The obtained charcoal briquettes displayed satisfactory mechanical strength and excellent quality based on proximate and ultimate analysis. These findings demonstrate that coir pith holds significant potential for the production of charcoal briquettes, making them a viable and sustainable alternative to traditional charcoal.

The charcoal briquettes produced from the studied species exhibited favorable characteristics, including a higher calorific value, lower moisture content, increased fixed carbon levels, and reduced sulfur content. These attributes align with international acceptable standards, positioning these bio-briquettes as an environmentally friendly option. Their combustion results in reduced carbon emissions, contributing to a cleaner atmosphere, while also mitigating health hazards associated with the use of traditional fuel wood.

Moreover, the utilization of PEATKOL Dots as a substitute for commercial charcoal offers numerous advantages, such as cost savings and reduced deforestation. By promoting the adoption of these bio-briquettes, the research contributes to sustainable growth, decreased reliance on non-renewable resources, and conservation of forests.

Comparative analysis with commercial sawdust briquettes further validates the satisfactory performance of coir pith biomass charcoal briquettes. Their competitive characteristics, coupled with the abundance of coir pith as a readily available raw material, reinforce the feasibility of large-scale production and utilization in various applications.

In conclusion, the development of PEATKOL Dots using coir pith represents a significant step towards achieving sustainable and eco-friendly energy solutions. These bio-briquettes exhibit excellent fuel properties, making them suitable for domestic and commercial use. By harnessing the potential of coir pith, this research contributes to reducing environmental impact, promoting responsible resource management, and fostering a greener future. The results affirm the viability of coir pith as a potential biomass for charcoal briquette production, offering a promising pathway to address the pressing global challenges of energy sustainability and environmental preservation.

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