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THE FABRICATION OF BIOMASS CHARCOAL BY 100-LITTER CHARCOAL OVEN FOR INDUSTRIAL APPLICATION

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Abstract

Which the oven had the average temperature for 435.2 °C. In baking each type of wood would take the difference time due to the density of wood had difference with biomass charcoal was analyzed the pores, morphologies and dye absorption properties by Scanning Electron Microscope (SEM) and UV/VIS spectrophotometer respectively. All charcoal had adsorption rate to difference because the density and pores of charcoal. In experiment founded that takian charcoal could be the bast absorbing with it had the average absorption value for 0.28 nanometer due to it was hardwood and high density. Moreover, It had the large number of microporous morphologies vice versa, biomass charcoal for the least absorption that was stump charcoal for 0.05 nanometer because it was low density wood and it had the least pores among all charcoal. In part of rubber charcoal, neem charcoal and bamboo charcoal had the similar adsorption rates about 0.12 - 0.15 nanometer due to it had the similar morphologies and pores.

Keywords; Biomass charcoal, Porosity, Absorption

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Introduction

A reassessment of the wood energy situation in developing countries, mostly, energy is an essential element of economic and societal growth. Energy from biomass has significant potential to have an impact on the developmental challenges of rural poverty and environmental degradation. Biomass provides about 12–15% of global energy needs. In developing nations, biomass is the main energy source for over 80% of the population. Over 3 billion people rely on the traditional use of solid biomass for cooking and heating purposes M. Lubwama. (2023). which are in tropical regions, revealed that in Asia and Africa consumption of wood energy is declining although consumption in Africa remains high while in South America, where wood energy is less important, overall consumption appears to have been rising slowly M.Arnold, R.Persson. (2003) with high levels of poverty, the dependence on biomass energy sources continues to rise in sub-Saharan Africa C. May-Tobin. (2011). This trend, coupled with inefficient wood fuel production and consumption practices, and inaccessibility by most households to other reliable and affordable commercial energy forms, is not likely to change in the near future. Charcoal is a fuel that is produced by carbonization of biomass with call Pyrolysis process N.Emmanuel Chidumayo, J.Davison Gumbo. (2013).

Pyrolysis process classified as a thermal process for using decompose biomass under low oxygen as charcoal in various forms A.V.Bridgwater. (2012). Which Popular fast pyrolysis select in the property changing of biomass as liquid fuel called bio-oil. Due to the volume up to 75% while intermediate can make 50% by fast pyrolysis will use the temperature at 500^{o}C more over main product It also creates secondary products as gas 13% and charcoal 12% O.Maneerat et al. (2018). Charcoal is a lightweight black carbon residue prepared by eliminating water and other volatile elements from animal as well as vegetation substances J.Ajith Kumar et al. (2021). Additionally, there is a research report that investigates the yield of a diverse range of pyrolysis products and assesses the performance of a small pilot reactor for slow pyrolysis of four tropical wood species at five different temperatures (300, 350, 400, 450, and 500 °C).The study results indicated that charcoal yields ranged from 28.2 to 56.6%, bio-oil from 2.8 to 8.1%, while yields of non-condensable gases varied from 14.0 to 33%, and wood vinegar yields ranged from 25.6 to 40.8%. It was also found that temperatures of 300–350 °C were suboptimal due to incomplete pyrolysis of the wood, making them unsuitable for use. Charcoal yields were consistent between 400 and 500 °C, whereas the production of condensable substances (wood vinegar and bio-oil) and non-condensable gases reached their maximum at 500 °C; however, the yield of charcoal was lowest and the charcoal was brittle R. Moya et al. (2024).

Charcoal had the generally benefit of using charcoal rather than just firing wood is the elimination of water and other constituents, which allows the charcoal to burn to a higher temperature. Also, the combustion of charcoal is nearer to complete combustion so that the end products of combustion are mainly carbon dioxide with a very little smoke. charcoal consists of varying quantities of hydrogen as well as oxygen in addition to ash along with other impurities which, together with the structure, decide the properties of the charcoal S.C.Bhattacharya et al. (1990). For the production of charcoal for industrial applications, studies have found that producing charcoal for metallurgical purposes requires careful selection of the wood species and control of pyrolysis conditions to achieve optimal charcoal quality. The main properties of charcoal that need to be considered include density and reactivity A. Dufourny et al. (2019).

In this work we used the biomass from industrial plant for taking to biomass charcoal to study about the physical structure and charcoal absorption properties. By selection wood chips to test 5 type including rubber wood, takian wood, bamboo wood, neem wood and stump wood. Moreover, we select the 100-liter charcoal oven for conversion wood into charcoal after that, take the charcoal to analyze about physical properties and chemical for industrial application.

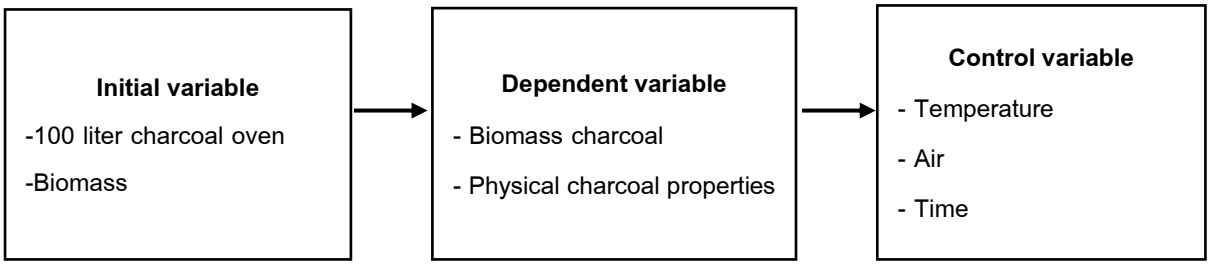
Objective

- To study the structure of each type of charcoal.
- To take the charcoal to applies as absorbent.
- Reduce the problem of biomass waste from agriculture.

Importance of research

- Knowledge about wood for making charcoal
- Knowledge about oven construction process
- Take the knowledge to applies for daily life to benefit.

Research conceptual framework



Research hypothesis

- 100-litter charcoal oven have good physical properties
- The 100-litter charcoal oven have total weight not more than 15 kg. and movable

Experimental detail

The changing wood into charcoal

In this research selected the 100liter biomass charcoal oven **(see Fig. 1)** to bring to baked and selected old oil combined with fire wood as the fuel to heating. Which the temperature value of oven was about 400 - 450 degree.

Fig.1 Showed the nature of 100 litter biomass charcoal oven

With there were the wood chips preparation for using to change as charcoal of 5 type namely, takian wood, rubber wood, bamboo wood, neem wood and stump wood. Each species of wood had the weight about 50 Kilogram for experiment. While the time for baking was used different **(Table1)** due to the thickness of each wood are difference moreover, moisture of, wood was difference. We took note about temperature for 10 minutes **(Fig.2)**

Fig.2 Showed the nature of 100 litter biomass charcoal oven

Then take out the charcoal from the oven, the charcoal must be at normal temperature otherwise, it would turn charcoal into ashes.

Table.1 *Experiment of wood baking for biomass charcoal making.*

Weight of wood before baking (50 Kg.)					
Type of wood	Takian wood	Neem wood	Stump wood	Rubber wood	Bamboo wood
Time for baking (min)	480	420	380	300	240
Average temperature (°C)	447.6	440.1	431.4	429.7	427.2
weight become charcoal (Kg.)	9.2	8.8	8	7.6	4.2

After getting biomass charcoal, the sample was analyzed absorption properties by UV/Vis Spectrophotometer with selection fabric dye combined with distilled water in the ratio 1 litter per 0.01 gram and biomass charcoal about 2 grams. Moreover, adsorption experiment of each type biomass charcoal as 60 minute which recorded the results every 10 minute.

Morphologies and Porous of biomass charcoal were analyzed by Scanning Electron microscope (SEM) with the properties of biomass charcoal would be appropriated to taking for using would be discussed in next section.

Results and discussion

The surface and morphology of biomass charcoal after absorption were showed in **fig.3(a)-(e)** noticed that biomass charcoal with hard surface they had the largest number of microporous morphologies in the nanometer level.

Takian charcoal had the largest number of porous morphologies followed by rubber charcoal, neem charcoal, bamboo charcoal and stump charcoal respectively. With each type of biomass charcoal took the time for absorption about 60 minutes.

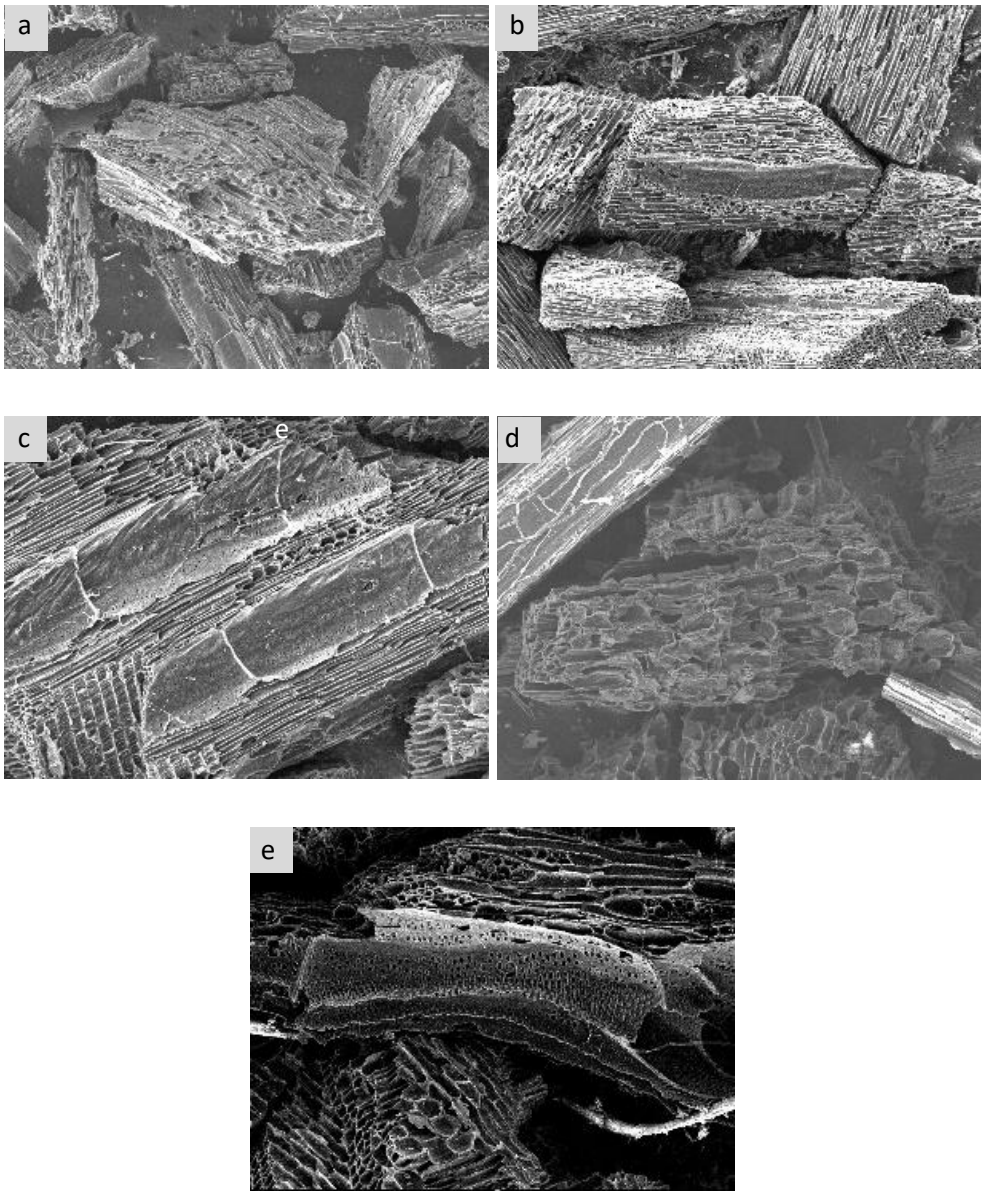


Fig.3 (a)-(e) Showed the SEM results of charcoal after absorption.

After that, they showed absorption results each type of biomass charcoal with recording the value 3 time for experiment which they would show in **fig.4(a)-(e)**. noticed that the takian charcoal had the best dye absorption, they had averaged absorption at 0.28 nm., rubber charcoal 0.15 nm., neem charcoal 0.12 nm., bamboo charcoal 0.12 nm. and stump charcoal 0.05 nm. respectively. Moreover, in 40 minute of the bamboo charcoal emitted dye because it was a less porous charcoal. But had a very small size. As a result, there was a large amount of dye in the fabric.

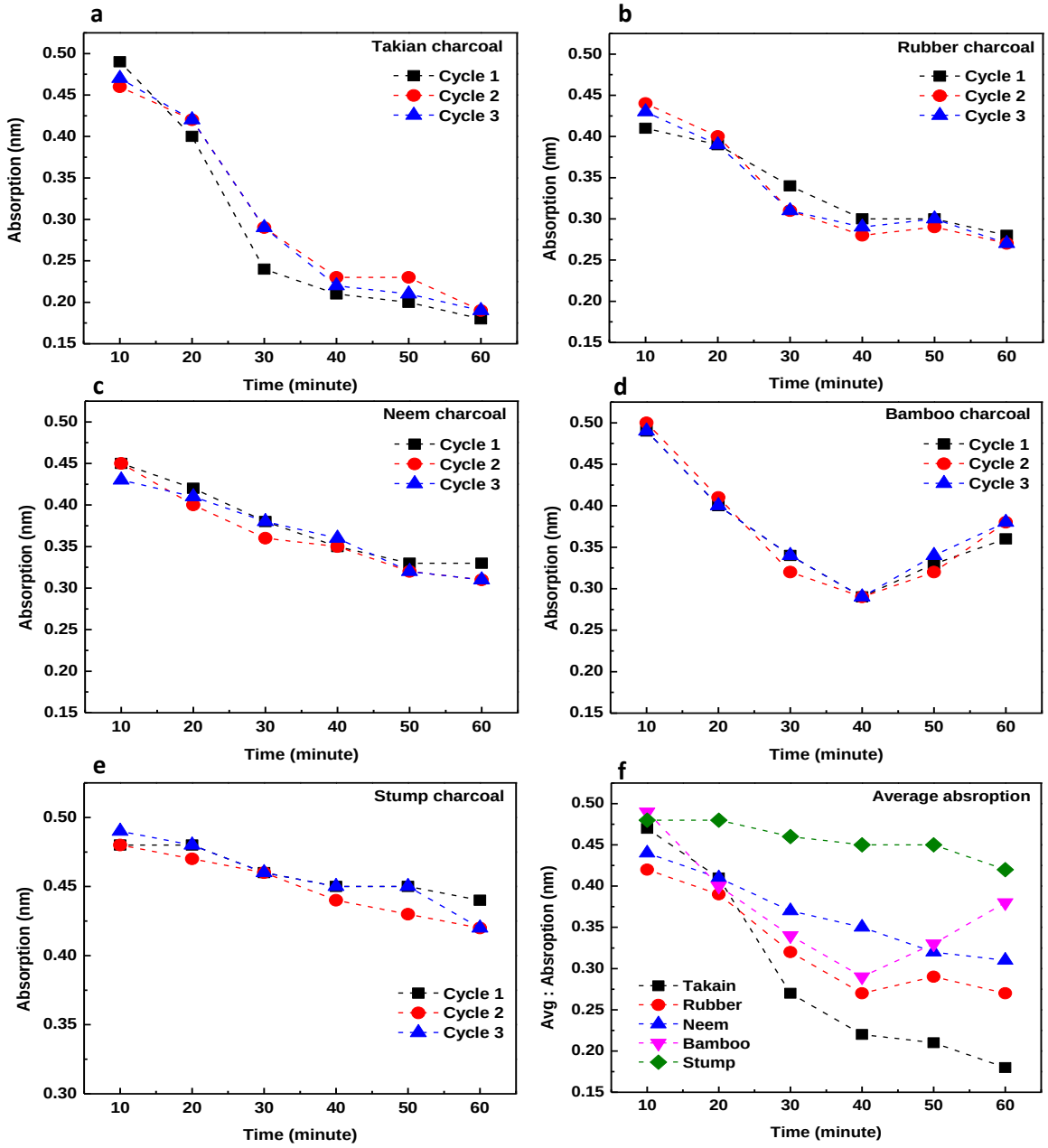


Fig.4 (a)-(e) Biomass charcoal Absorption of all 5 types select time for absorption at 60 minutes and ***(f)*** *show the average absorption of 5 type of biomass charcoal at 60 minutes.*

Conclusion

Charcoal baking used the 100-liter charcoal oven with the oven had average temperature about 435.2 ºC causing the wood turn into completed charcoal. But taking the time for difference baking due to the each of woods had the difference thickness. Which found that takian charcoal had the best absorption because it is hardwood had many small pores which was appropriate to absorb. Vice versa, stump charcoal was the biomass charcoal with least absorbed and they spited dye while doing tested due to they were softwood, little space. Moreover, the charcoal porosity had a little and large. Therefore, density of charcoal and porosity had the effect for absorption.

Suggestion, studies about other woods for making the charcoal to test absorption in next time and develop charcoal oven to have a larger size in order to accommodate more amounts of biomass.

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