



Activated Charcoal from Bio-Mass of Palm (Arecaceae) Tree

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ABSTRACT: Palm (Arecaceae) tree, a plant from perennial family, is found abundantly in coastline area. It is commonly used as decorative plant for gardening. In the present study the dried Palm leaves are used to prepare and analyze the activated charcoal using calcium chloride as an activating agent and its physicochemical properties are determined. The proximate analysis of study shows that 35% volatile matter, 25% ash content, 34% fix carbon and 6% of moisture content are present in the charcoal. With the help of CHN analyzer ultimate analysis was carried out for carbon, hydrogen and nitrogen. The objective of the study was to find out whether this charcoal could be used as low-cost adsorbent as alternative to commercial activated carbon.

KEYWORDS: Palm tree (Arecaceae), Bio-mass, low-cost adsorbent, Proximate analysis, CHN analyzer..

I. INTRODUCTION

Generally activated carbon can be produced from two resources raw carbon resources and biomass resources. The lignite, peat and coal are raw carbon resources and wood, sawdust, bagasse, coconut shells [M.K.B. Gratuito] and Palm (Arecaceae) nuts are bio-mass resources [daniel]. The biomass being abundantly available as a raw material for the production of activated carbon makes the process more economical. The activated carbon can be produced by either physical or chemical activation. The material, in physical activation, is carbonized under inert atmosphere and then activated at high temperature using either steam or carbon dioxide as an activating reagent. The precursor, in chemical activation, is treated with chemicals to help initial dehydration. Palm trees are most likely situated in coast line area. This kind of plant is of perennial family background of the monocot order Arecales. Palm (Arecaceae) tree is commonly used as decorative plant and mostly found in the garden of Indian cities. It can grow 4 to 20 feet high and 9 feet trunk diameter.

Basically, the word 'Palm (Arecaceae)' is used for climbers, shrubs and stemless plant. Trees which have quality like Palm (Arecaceae) are called Palm (Arecaceae) tree [7]. At present 181 genera and 2600 species of Palm trees are recognized [17]. A human race has been using this tree since dawn of the civilization. History said that even before human civilization humans were using this Palm tree. The number says that middle east peoples and Mesopotamians had been using it for 5000 years or more ago.[1]

The Arecaceae tree produces huge amount of bio mass in the form of dry leaves and branches of tree. This bio- mass burned openly and produce high amount of smoke and it is harmful to the environment. This problem can be encountered by testing its charcoal properties. The activated charcoal can used as an alternative adsorbent in Chemical and Petrochemical industries..

The paper is structured as follows: Section II outlines the materials and methodology employed for the preparation of activated carbon from Arecaceae biomass. Section III discusses and interprets the results of the Carbon-Hydrogen-Nitrogen (CHN) analysis. Finally, Section IV presents the conclusions of the study.

II. MATERIAL AND METHODS

2.1 Preparation method of Activated Carbon.

The bio-mass of Arecaceae tree was collected from the Konkan region of Maharashtra, India. The process involves two steps, one carbonation and activation. In Carbonation step, these tree leaves are carbonized in a furnace at 240°C for 1hr in the absence of air. After carbonation, the sample was crushed and it was soaked in 25% concentrated solution of Calcium Chloride for 24 hrs. Finally, the soaked and activated carbon sample was dried in an oven at 105°C for 1hr [9,11,12,15,14,16].

2.2 Carbon Hydrogen Nitrogen analysis (CHN analysis)

The amount of Carbon (C), hydrogen (H) and nitrogen (N) of an activated charcoal was measured by CHN (carbon hydrogen nitrogen) analyzer. Model component FLASH EA 1112 series is based on principle of 'Dumas Method'. It involves instantaneous and complete flash combustion of sample. It has great accuracy to analyze the carbon, hydrogen and nitrogen. Calibration method used for analysis was k type. The total sample weight was 2.588 g and the Protein factor was 6.25 [8,13,14].

2.3 Proximate analysis.

2.3.1 Volatile Matter.

The sample was weighted (W_s) and placed in a closed crucible (W_c). It was heated in a furnace at 925°C for 7.5 min. The crucible was then cooled in a desiccator and weighed (W_{cf}).

$$V_m = \frac{(W_s + W_c) - W_{cf}}{W_s + W_c} \times 100 \quad (1)$$

Volatile matter measured from bio-mass of Palm tree was 35%. W_{cf} is weight of crucible having sample after furnace and V_m is volatile matter of a sample [2,10,11].

2.3.2. Ash content

The sample was measured (W_{AS}) and taken in a crucible (W_{AC}). It was heated to 750°C for 1.5 hr. During this test the crucible was left open. After the required heating, the crucible was cooled in a desiccator and then weighed (W_{Acf}). The Ash content of sample was calculated by [Eq.2].

$$A_c = \frac{(W_{AS} + W_{AC}) - W_{Acf}}{W_{AS} + W_{AC}} \times 100 \quad (2)$$

The ash content measure from bio-mass of Palm (Arecaceae) tree was 25%. While W_s is Weight of sample, W_c is Weight of crucible, W_{cf} is Weight of crucible and sample after furnace and A_c is ash content of a sample [3,10,11].

2.3.3. Moisture content:

Sample was taken in a petri dish (W_{ps}) and measured the weight of petri dish and sample (W_p). It was spread uniformly on the dish. It was then heated at 105°C for 1.5 hr. the petri-dish was left open during the heating process. After heating petri-dish was cooled in desiccator and weighed (W_d). The calculation of moisture content was done by [Eq.3].

$$M_c = \frac{(W_{ps} + W_p) - W_d}{W_{ps} + W_p} \times 100 \quad (3)$$

The ash content measure from bio-mass of Arecaceae tree was 25%. While W_s is Weight of sample, W_c is Weight of crucible, W_{cf} is Weight of crucible having sample after furnace and A_c is ash content of a sample [3,10,11].

2.3.4. Fix Carbon:

The fix carbon of a bio-mass of Arecaceae tree was calculated as given in [Eq.4]

$$F_c = 100 - v_m - A_c - M_c \quad (4)$$

Fix carbon percentage from biomass of Arecaceae tree was calculated as 34%. While V_m is volatile matter, A_c is ash content, M_c is moisture content and F_c is fix carbon of sample [5,10,11].

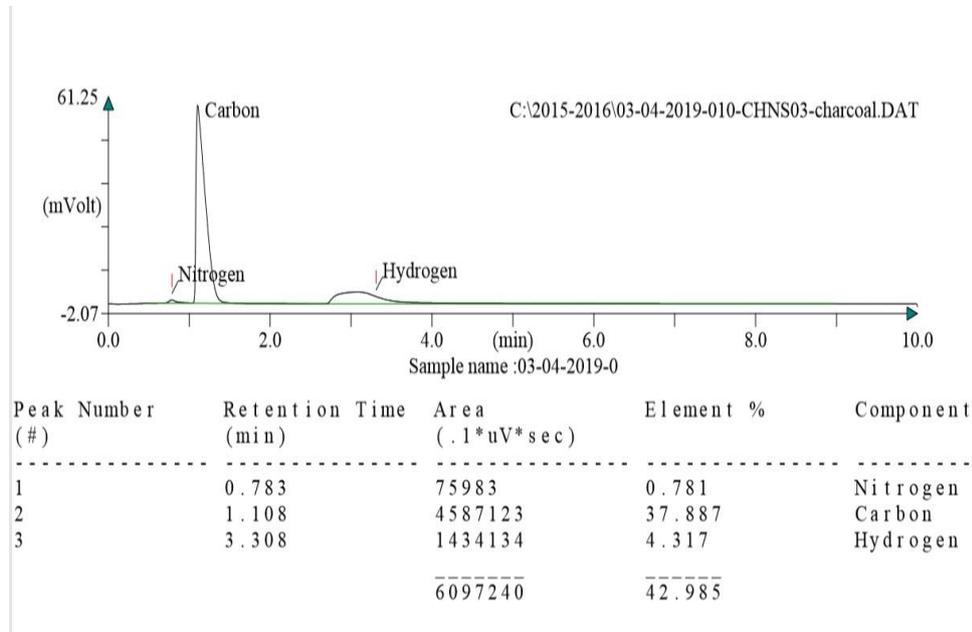


Figure 2.1: Carbon Hydrogen Nitrogen Analysis (CHN Analysis)
(Sophisticated Analytical Instrument Facility (SAIF) IIT Bombay)

Table 2.1: CHN analysis of activated charcoal from biomass from Palm tree.

Compounds	Percentage (%)
Carbon	37.887
Hydrogen	4.31
Nitrogen	0.781
Sulphur	-

III. RESULT AND DISCUSSION

3.1 Carbon Hydrogen Nitrogen Analysis (CHN analysis) result

The CHN analysis results elucidate and corroborate that sufficient amount of carbon is available in Palm tree. The tallest peak of the plot [Figure 3.1] indicates the amount of carbon available in activated charcoal of Palm tree. Hydrogen and nitrogen present in biomass are in very less quantity.

3.2 Proximate Analysis result.

The Proximate analysis of bio-mass from Palm (Arecaceae) tree was performed at laboratory level. The proximate analysis result indicates that high amount of volatile matter was present in bio- mass of Palm tree. It also identifies that the moisture content in Palm (Arecaceae) tree was very low which is make a positive impact towards this research. It is necessary to reduce the amount of volatile matter from Palm (Arecaceae) tree results in increase in carbon percentage.



IV. CONCLUSION

Production of activated charcoal from bio- mass is useful for the reduction in bio- waste which is burnt openly and produce high amount of smoke results in pollution. The activated charcoal produced from the biomass will be available as an alternative low-cost industrial adsorbent for Chemical and Petrochemical industries. It will show very positive impact on both environment as well as industries. From the CHN analysis and proximate analysis it was clearly observed that there being not much difference in the fixed carbon content, both are viable options for activated carbon production. The proximate and ultimate analysis give an idea about fix carbon present in bio-mass of Palm (Arecaceae) tree.

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