International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Preparation of Activated Carbon Using Wood Apple Shell

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ABSTRACT

In order to make activated charcoal, wood apple fruit shells that have been sun dried are used as precursors. Acetic acid is used as the activating agent, and it is harmless and acceptable for purifying drinkable water. The activating agent's various properties, including activation duration, concentration, and impregnation ratio, were examined. To achieve the best results in terms of activated charcoal quality and production, carbonization was carried out at various temperatures between 300 and 450 °C. In terms of cost, effectiveness, and simplicity of preparation, the method was determined to be superior to other ones that were already in use. Key words: Acetic acid, activated charcoal, wood apple fruit shell, impregnation ratio, carbonization. A material having distinguishing qualities including high specific surface area, high porosity, and desired surface functionalization is activated carbon, which is inexpensive. As a result, activated carbon is widely employed for practical purposes in adsorption, pollution removal, water treatment, and energy.

1. INTRODUCTION

Ancient cultures valued activated charcoal highly and employed it for a variety of uses. Because of its superior adsorption qualities, low price, and ease of availability, it has recently gained popularity as a water purification solution. Applications for activated charcoal can be found in the food, cosmetics, medical, pharmaceutical, electrical, electronic, and nanotechnology industries. The laborious and time-consuming process of producing activated charcoal demands a lot of energy and a high temperature. The price of raw materials used as precursors is relatively high. Another crucial phase in its manufacturing is the choice of the activation agent. NaOH , HSO [5-7], Na,CO [8], steam activation, KOH , MgC , Steam-N [112], and ZaCl are the activating agents used to prepare activated charcoal. H,PO,

Activated carbon, sometimes known as activated charcoal, is a type of carbon that is frequently used for a variety of purposes, including the filtration of impurities from water and air. It is processed (activated) to have tiny, low-volume holes that enhance the surface area[1][2] that is available for chemical reactions or adsorption, which is different from absorption.[3] Making popcorn from dried corn kernels is comparable to activation because popcorn is airy, fluffy, and has a large surface-to-volume ratio. Sometimes, active is used instead of activated.

Purified charcoal in powder form is called activated carbon. It is subjected to physical or chemical treatment to produce microfissures, greatly enhancing its adsorptive surface area. Numerous polar chemicals, particularly phenols and their derivatives, can be successfully adsorbed thanks to the large surface area (500–1500 m2/g) and electrical charge.

Carbonaceous source materials, including coconuts, nutshells, coal, peat, and wood, are used to make activated carbon. Any organic material with a high carbon content serves as the main source material for activated carbon.

Kingdom : Plantae Division :Magnoliophyte Class :Magnoliopsida

Order : Sapindales

Family : Rutaceae

Genus : Limonia

Species : L.asidissima

CHEMICAL PROPERTIES OF WOOD APPLE

Hows that wood apple fruits are high in minerals (1.9%), proteins (7.1%), fat (3.7%), carbs (18.1%), and fibre (5.0%). Calcium (130 mg/100 g), phosphorus (110 mg/100 g), and iron (0.48 mg/100 g) are the three major minerals [3].

2. METHODS AND MATERIALS

A. Basic component

Apple fruit shells from wood (WFS) are used as a starting material to make activated charcoal. To get the dust off its surface, the fruit shells were washed in water many times. The shells were allowed to air dry in the sun for a few days. Using a home mixer, the sun-dried shells were then crushed and ground to the required particle size. The crushed and ground shells were cleaned with distilled water to get rid of the fine dust before being dried for two to three hours at low temperatures in a hot air oven before being sealed in plastic bottles.

B. Active substance

Acetic acid was used as the activating agent in a chemical activation process to activate the air-dried WFS. The impregnation ratio ranged from 3.5 to 12:25, and the ground material (3.11mm) was steeped in acetic acid solution. The weight of the activating agent to the weight of the raw material was used to calculate the impregnation ratio.

C. Time of activation

To investigate the influence of activation time, a 40% acetic acid was chosen. For 12-48 hours at room temperature, the dried material (30 g) was soaked in 50 cc of an acetic acid solution. The sample was decanted and dried in a hot air oven at 70 °C for roughly two hours after the activation hours had passed.

D. Carbonization threshold

In a muffle furnace, carbon was produced from the dried activated sample. The furnace's temperature was raised gradually to the final, pre-determined temperature, which ranged from 300 °C to 450 °C in an inert environment. It was held at the maximum ultimate temperature for 15 minutes.

E. Washing

After being cleaned with distilled water to remove excess acetic acid, activated charcoal (WFS-AC) was dried in a 150°C air oven. Weighing the dried good, we estimated the percentage yield.

F. Yield in percentages

The following formula was used to determine the activated charcoal's percentage yield:

yield in percentages = W1/W2x%100

W1, the dry weight (g) of the finished activated charcoal, and W2, the dry weight (g) of the precursors Distillation

STRUCTURE OF ACTIVATED CARBON

1. **Porous structure Activated Carbon**

The higher adsorption capacity of activated carbon mainly depends on the porous characteristics such as pore volume pore size distribution, and surface area. Activated carbon contains up to 15% of ash content in the form of mineral matter (Bansal et al 1988). Porous structure of activated carbon forms during the carbonization and further develops during activation. All activated carbons have porous structure. The pore system of activated carbon are different types and individual pore may vary in both size and shape. Activated carbons are having pores from less than nanometer to thousand nanometers. Pores are classified on their average with Average width is the distance between the walls of slit shaped pore or the radius of a cylindrical pore. Conventional classification is proposed by (Dubinin et al 1960) and it is officially adopted by International Union of Pare and Applied Chemistry (UPAC).

2. Crystalline structure

During carbonization, microcrystalline structure of activated carbo develops. Activated carbon structure is different from that of graphite with respect to the interlayer spacing. In graphite interlayer spacing is 0.335 nm and in activated carbon is 0.34 to 0.35 mm Activated carbons are classified into two types, based on graphitizing ability, these are graphitizing and non-graphitizing carbons. In graphitizing carbon, contains number of graphene layers oriented parallel to each other. The carbon obtained was delicate due to the weak cross linking between the neighbor micro- crystallites and had a less developed porous structure. The non-graphitizing carbons are hard due to strong cross linking between crystallites show well developed micro pores structure (Franklin 1951, Jenkins and kawamura 1976). The formation of non-graphitizing structure with strong cross- links is promoted by the presence of associated oxygen or by an insufficiency of hydrogen in the original raw material. The schematic representations of the structures of graphitizing and non-graphitizing carbon.

3. PROCEDURES

3.1 COLLECTING OF RAW MATERIAL

(Fig 3.1 collection of wood apple)

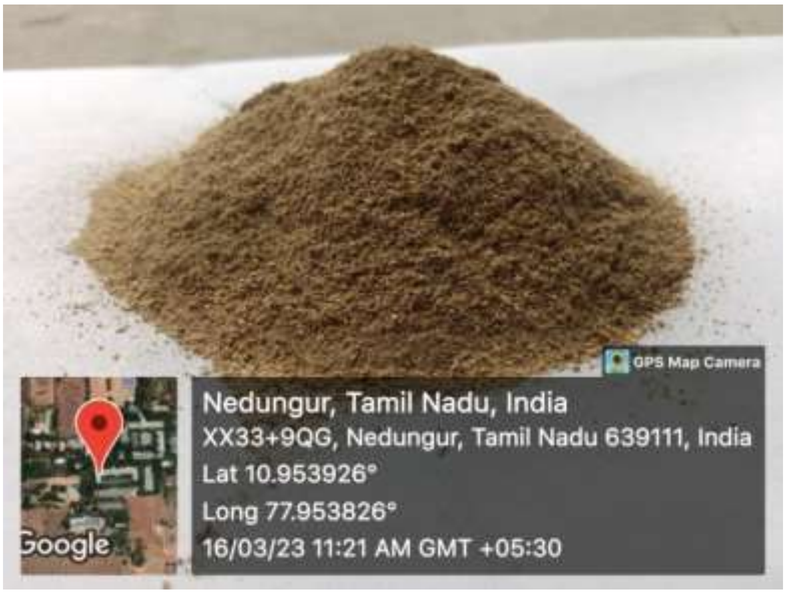
Cost effective, rapid and convenient method has been established for preparation of activated charcoal from sun dried Wood apple fruit shell as precursors using acetic acid as activating agent which is nontoxic and suitable for treating potable water. The various parameters such as activation time, Concentration and impregnation ratio of the activating agent was analysed.

3.2 EXTRACTION OF SHELL

(Fig 3.2 extraction of shell)

Carbonization was conducted at different temperatures in the range of 300 0 C to 450 0 C to get the best results in the terms of quality and the yield of activated charcoal. The method was found to be superior compared to other existing methods in terms of its cost, efficacy and ease of preparation.

3.3 MAKING POWDER BY USING CRUSHING



(Fig 3.3 crushing powder)

Transfer the thoroughly cleaned charcoal to a mortar and pestle and powder it up. Alternately, you might place the carbon in a strong plastic bag and use a hammer or tenderising mallet to smash it into a fine powder. Allow the charcoal powder to completely dry out in the air.

3.4 Well mixing of arthophosphoric acid and water

(fig 3.4 mixing of arthophosphoric acid and water)

Concentrated sulfuric acid (H 2 SO 4) combines with carbon to produce three gases: carbon dioxide, water, and sulphur dioxide. Preferential Attachment and Stronger Binding of Metal Nanoparticles on External Carbon Surface, with Higher Metal Ion Release, for Better Water Disinfectio

3.5 USAGE OF MUFFLE FURNACE IN ACTIVATED CARBO

(fig 3.5 muffle furnace)

In the muffle furnace, 300 g of dry coffee dregs are calcined for 3 hours at 900 °C. The resulting carbon is then exposed to 20 mL of 10% sulfuric acid and heated to 65 °C for one hour. The carbon is next filtered, cleaned with deionized water, and dried for an hour on a stove at 110 °C.1

3.6 ROLE OF ETHANAL IN ACTIVATED CARBON

(Fig 3.6 ethanal in activation carbon)

On both methods, the percentage of ethanol absorbed was comparable. After pretreatment with activated charcoal, the mean peak ethanol concentration was 8% higher than it was when ethanol was used alone ($p = 0.08$). As a result, individuals who require oral ethanol can utilise oral activated charcoal because it does not significantly decrease ethanol absorption.

4. RENEWABLE RESOURCES OF ACTIVATED CARBON

A excellent example is the preparation of activated carbon from biomass resources like different trees, leaves, plant roots, fruit peels, and grasses The most often utilised raw materials are peat, coconut shells, soft and hard wood, and coal (including anthracite, bituminous, sub-bituminous, and lignite)..

5. ACTIVATED CARBON IN WATER TREATEMENT

Wastewater is processed in several locations to provide clean water. Utilising activated carbon for wastewater treatment that uses adsorption is one approach. This is how molecules, atoms, or ions attach to the activated carbon particles' surface.

(Fig3.7 activated carbon in water treatement)

6. CONCLUSION

You can utilise the wood apple fruit shells as predecessors to make activated charcoal. Its activation is made non-toxic by the use of acetic acid as an activating agent. It is highly porous and effective at adsorbing due to the decrease in yield, which makes it perfect for the chemical and water purification industries.The wood apple fruit shell can be successfully employed as a precursor in the production of activated charcoal. Its non-toxic character is due to the activation process using acetic acid as an activating agent.

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