# Preparation And Characterization Of Activated Carbon Derived From Wood Shavings By KOH.

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**Abstract :**

In recent years, water pollution is one of the most problems and most dangerous for human health and economic development. A series of activated carbon were prepared through chemical and physical activation. In this work nanoform of activated carbon was prepared from Lignocellulose biomass derived from(wood shavings) activated with chemical activation Potassium Hydroxide(KOH). The activated carbon was preparae with a KOH/Lignocellulose ratio of ( 0.25:1, 0.5:1, 1:1,2:1) weight ratio. The effect of KOH mass and temperature in inert atmosphere on the yield and characteristics of the activated carbons were studies. The yield of activated carbons decreased with increased impregnation ratio and temperature,the lowest yield of activated carbons with KOH were obtaind at the $800^0$C with 50 wt% (KOH/LB). The Activated carbons were characterized by some techniques including XRD, SEM, TEM.

**Key words** :Lignocellulose, activated carbon, KOH

## Introduction:

The release of huge quantities of organic and inorganic pollutants into the environment due to contamination in the water, death of grassland,food chain, also in the atmosphere and generates different types of pollutions this is cause toxic,mutagenic and carcinogenic. Dyes are considered as colored ionized aromatic organic materials and required by numerous industries such as paper, leather, textile and plastic. Dye is one of the major involvement and the discharging of such contaminations causes a bad effect on human, fish species. Polluted wastewater loaded with dyes that has chemical stability,high biochemical oxygen demand and persistent colour[1]. Several techniques were used to remove the dyes species from wastewater such as adsorption, electro-coagulation, advanced oxidation process, ion exchange, biological treatment, coagulation and flocculation ,electrolysis,oxidation and photocatalytic degradation. Adsorption is considered the most effective process used in industries to remove the toxic chemicals present in the effluent by transferred from the solvents to the solid phase, also the adsorption is available, easy to operate , simple to design and low cost [2,3]. Activated carbon is the commonly used adsorbent for removal dyes and heavy metals and phenolic compounds. Activated carbons are the amorphous form, high surface area, high internal porosity and high adsorptivity[4]. Low cost sorbents obtained from agricultural waste,plant, rice husk,a straw, coir, sawdust and wood wastes can be derived from biomass resources by differents types of chemically activating agent such as $H_2SO_4$, HCl, $Na_2CO_3$, $K_2CO_3$,$H_3PO_4$, KOH and NaOH[5].

## Materials and methods

### Materials

Wood shavings, the raw materials obtained from a local market, Potassium Hydroxide(KOH),Double- distilled water(DDW) was used to wash and prepare the aqueous solutions for the experiments. The chemicals in this work were used without purification and the experimental solutions were prepared by using high-purity deionized water.

### Preparation of nano activated carbon

The wood shavings is a raw material was obtained from a local market in Al-Diwaniyah city in south of Iraq(Fig 1a),followed by chemical activation with Potassium Hydroxide(KOH). The raw material was washed with DDW and then oven-dried at $105^0$C for 4 h. An accurately weight 3g of dried powder was impregnated with (0.25:1, 0.5:1, 1:1, 2:1) in 30% aqueous solution and placed in a crucible for 16 h, then the mixture was dried in an electric furnace.Carbonization process of the impregnated sample was conduct at different temperatures ranging from $400^0$C to $800^0$C for 50 minutes under an inert gas(nitrogen atmosphere). To remove the chemical activating agent the sample was washed with hot water and cold distilled water until the washing water reached a neutral pH , the liquid phase was removed by centrifugation at 6000 rpm and then the activated carbon nanoparticles were dried in $105^0$C for 6hs in an oven-dried(Fig 1b)[6,7]. The yield of the activated carbon was determined with the equation below:

$$Y= M_1/M_2 \times 100\% \quad (1)$$

Where $M_1$ is the mass of activated carbon, $M_2$ is the mass of oven-dried raw material[8].

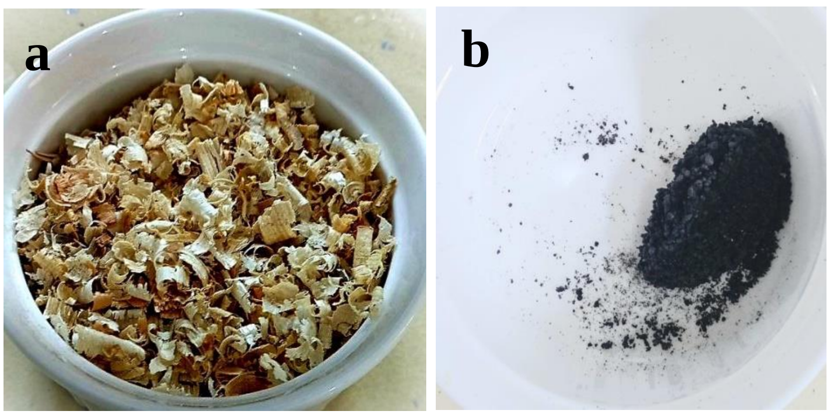


**Fig 1. Raw material (a), Activated carbon( b)**

## Characterization

XRD-6000, Shimadzu-Japan was used to recording powder X-ray diffraction patterns at diffraction angles scanned from $10^0$ to $80^0$ to investigated the crystalline structure. Transmittance electron microscopy images (TEM) Philips model FEI, Quanta 400 was adopted to and the scanning electron microscopy (SEM) was used to characterize the surface morphology and composition of raw materials and activated carbon.

## Results and Discussion

### Effect the ratio of activating agent to lignocellulose on yield

Product of yield is an important factor to evaluating the effect of KOH/LB weight ratio on AC synthesis.The effect of KOH to lignocellulose ranging ratios from 0.25 to 2,at $800^0$C and $40^0$C.The results appear that the maximum values for yield due to wide pores with increasing the ratio of KOH/Lignocellulose 0.5,when the ratio arrived at a certain value the pores burnt off [9], increased dose of KOH leading to the widening and collapse of the framework structure due to decline the surface area of activated carbon[10].

## Mechanism of carbonization and activation with KOH

Activated carbon can be obtained by chemical activation of industrial waste by using types activating agents such as NaOH ,$K_2CO_3$, $H_3PO_4$,$ZnCl_2$,KOH and $H_2SO_4$. KOH is a popular chemical activator due to its strong basic properties to destroy the carbon to wall produced activated carbon with porousity and higher surface area. Biomass-derived activated carbons are promising raw materials can be used in varios applications. The characteristics of activated carbon depending on the characteristics of biomass used, Lignocellulose after pre- treatment with KOH the sample carbonized and activated.

The mechanism of activation with KOH in equation:

$$6KOH + 2C \rightarrow 2K + 3H_2 + 2K_2CO_3 \quad (2)$$

$$K_2CO_3 + 2C \rightarrow K_2O + 2CO \quad (3)$$

$$K_2CO_3 \rightarrow K_2O + CO_2 \quad (4)$$

$$2K + CO_2 \rightarrow K_2O + CO \quad (5)$$

When the precursor activated with KOH and carbonization around $400^0$C ,$K_2CO_3$ occurs and compeletly formed at $600^0$C. At $700^0$C $K_2CO_3$ decomposes to $K_2O$, CO and $CO_2$.The reaction between KOH and the precursor results more pore with high surface area, the mainly reaction appear that the amount of oxygen increased through activation by form of a C−O and C=O bonds[11-13].

## Characterization of activated carbon

### XRD analysis

The crystalline structure of the raw material(straw pulping) and activated carboby Potassium hydroxide(KOH) was investigated with XRD analyses. Fig 2a shows the results of XRD of the lignocelullose, the sharpness and intensity spectra of the clear peaks of wood shavings when compared with activated carbon.The sharp peaks of wood shavings are not observed in the spectra of activated carbon because of the amorphous structure Fig 2b,similar XRD peak patterns are noticed of the carbon precursors impregnated with chemical agent (0.5:1) ratio but less intensity [14]. The main peak in activation carbon attributed to $KHCO_3$, also weak peaks due to $K_4H_2(CO_3)_3$ which is as an intermediate composition of $KHCO_3$ crystals exposed to $CO_2$ atmosphere[15].

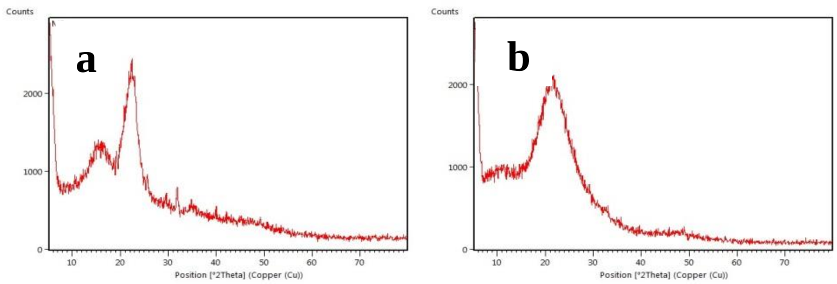


**Fig 2. XRD graph of(a), Lignocellulose (b) AC**

**SEM analysis**

The surface morphology of raw wood shavings and activated carbon were investigated using SEM. The SEM analysis of raw wood shavings and activated carbon were recorded in Fig 3 to study the effect of chemical activation by KOH. The surface morphology shows a significant difference between the raw material and AC. Fig 3a showed that the raw wood shaving exhibited a heterogeneous structure with no visible pores[16]. In Fig 3b showed the development of pores attribute to the chemical and physical activation process also small pores obtained from spaces created by vapourized moisture, cellulose , hemicellulose and lignin[12,17].

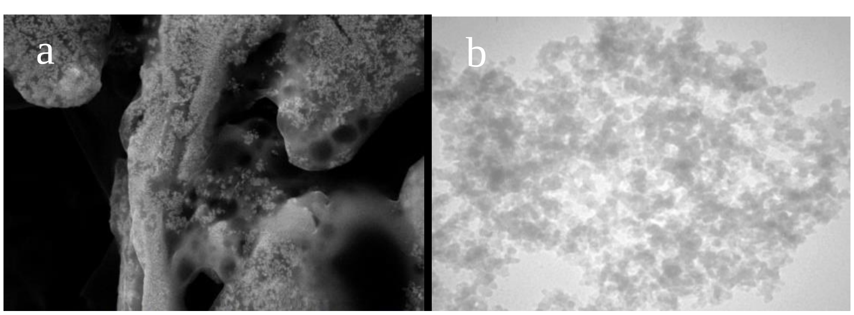


**Fig 3. SEM images of (a),Lignocellulose (b) AC**

**TEM analysis**

Transmission Electron microscopy and high –resolution was used to study the morphology and particles size of lignocellulose and activated carbon.Fig 4a-b .TEM have a better resolution,they are able to provides details a bout a samples size,composition ,shape and the degree of crystallinity also to the morphology of biomass that undergone chemical and thermal treatment. As a result, that the lignocellulose is microfibrils while the activated carbon with KOH results microporosity development [18,19].

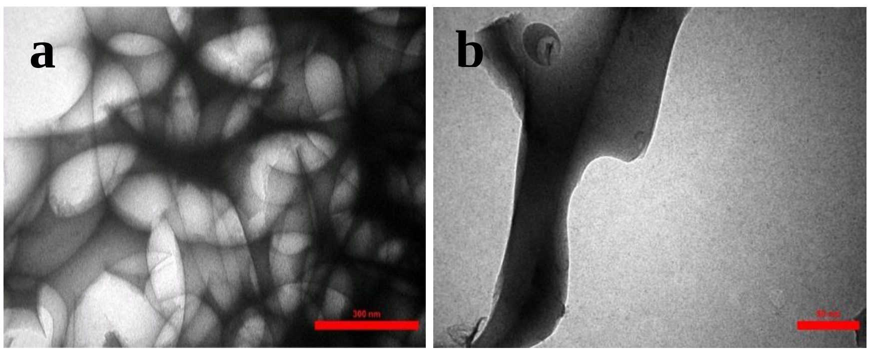


**Fig 4 . TEM results of ( a ) lignocellulose , ( b ) AC**

**Conclusions**

In this study, it is aimed to synthesis activated carbon from lignocellulose derived from wood shavings was produced.Chemical treatment with KOH ,physical activation were tested. Activated carbon with high surface area and low volume has been prepared.The impregnation ratio of KOH and temperatures significant on the characteristic of activated carbon. In order to obtained high surface area and achieve well- developed porosity, temperature should be within $800^{0}$ C. The activated carbon can be checked by using different applications.

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