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Studying the effect of reactor type on the efficiency of the prepared activated carbon From the wood of the lead tree by chemical treatment

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Abstract:

The research Aims to study the effect of the type of reactor (rust-resistant iron, Cupper, Aluminum, pyrex, tin-galvanized iron, pottery) on the properties of activated carbon prepared from the wood of the Lead Tree, after conducting a primary carbonization process for wood at a temperature of (350 °C) ,for a period of (3 hours) and after The carbonated substance is treated with potassium hydroxide in a ratio of (1:1) (potassium hydroxide: the carbonated substance), and then the carbonization and activation process takes place at a temperature of
(25 + 550 °C) for 2 hours,
after which the activated carbon prepared in the various reactors is purified and then a process is carried out Evaluation of the prepared activated carbon such as (Iodine number, methylene blue dye, moisture , density, ash content) and comparison of the results obtained from the use of different reactors.

دراسة تأثير نوع المفاعل على كفاءة الكربون النشط المحضر من خشب شجرة الرصاص بالمعالجة الكيميائية

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ملخص البحث:

يهدف البحث إلى دراسة تأثير نوع المفاعل (الحديد المقاوم للصدأ، النحاس، الألمنيوم، البايركس، الحديد المغلون بالقصدير، الفخار) على خصائص الكاربون المنشط المحضر من خشب شجرة الرصاص وذلك بعد إجراء عملية كربنة أولية للخشب عند درجة حرارة (٣٥٠ سيليزي) ولمدة ٣ ساعات وبعد ذلك تعامل المادة المكربنة مع هيدروكسيد البوتاسيوم وبنسبة(1:1) (هيدروكسيد البوتاسيوم: المادة المكربنة)،وبعدها تتم عملية الكربنة والتنشيط عند درجة حرارة (٥٥٠ + ٢٥ سيليزي) لمدة ٢ ساعة وبعد ذلك تتم تنقية الكاربون المنشط المحضر في المفاعلات المختلفة ثم إجراء عملية تقييم الكاربون المنشط المحضر مثل(الرقم اليودي، صبغة المثلين الزرقاء،الكثافة الرطوبة،محتوى الرماد) ومقارنة النتائج المستحصل عليها من إستخدام المفاعلات المختلفة.

Introduction

From charcoal, wood is characterized by its high carbon density compared to other types of vital materials such as herbs, and their types and quantities can be developed using modern technology. Wood is environmentally unpolluted in terms of its liquefaction products and combustion residues compared to coal and crude oil [2,1]. The studies of wood included several aspects, the most important of which is its liquefaction for the production of petrochemicals and industrial fuels, as well as obtaining the transactions and carriers of lignin in nature such as phthalene, for example. In addition to what was mentioned above, wood is used in the manufacture of cellulosic pulp, paper and photographic films [1,2]. The wastes of the wood industry have also been used in the carbon industry. activator. Activated carbon is defined as a porous substance in an amorphous form that suffers during its production, an imbalance in its crystalline structure and a deficiency in its hydrogen, and this defect leads to the appearance of pores that are unstable in terms of their energy content or effectiveness, and these pores are mostly found on the outer surfaces of grains Activated carbon, and sometimes it is internal, and the size of these pores exceeds the size of the pores in the usual types of carbon, and therefore its adsorption capacity is greater, so

it has been proven that activated carbon has a higher adsorption capacity than any other known substance on the surface of the earth [3,4].

With the continuation of dealing with carbon and the expansion of its use, the adsorptive properties of it were discovered, which greatly increased its importance. The first industrial applications of it were in Britain at the end of the eighteenth century, specifically in (1794 AD), when it was used in the sugar palace and the removal of colors from it. At the outbreak of World War I and the emergence of chemical weapons and the use of poisonous gases by the Germans in this war, the need for materials with high adsorption qualities emerged and here the importance of carbon in this area emerged, as manufacturers began to pay attention to this substance and improve its adsorption properties. And trying to produce them in a granular form of specific sizes for the purpose of using them in the manufacture of masks Gas protection.

For the preparation of activated carbon, various types of carbonic organic materials are used as raw materials, including wood, coconut husks, heavy oil residues and agricultural residues [5], The materials with high carbon content are preferred in the manufacture of activated carbon (6) . and when referring to the literature on the materials used and the methods used in preparing Activated carbon Several different materials and methods can be observed in preparing activated carbon, including:

Powdered activated carbon (PAC) was prepared from leather polishing waste, sawdust and lignite by carbonization at temperatures ranging from (800-500°C) , followed by steam activation. The experimental results revealed a general decrease in the yield of carbon residues with increasing carbonation temperature. Lignite samples recorded the highest yield (67.70-49.80%) followed by leather polishing dust 39.70-30.70% (and sawdust 37.20-25.10)%. Carbon production with better absorption efficiency, while high-temperature carbonization produces carbon more efficiently than sawdust and lignite [7]. Hammadi studied the preparation of activated carbon from sawdust, and after the carbonization process of sawdust, this study gave good results [8]. (Jungten) has prepared activated carbon from one of the types of wood rich in lignin with elemental sulfur under thermal conditions that are not too harsh, as the results after crushing it showed that it has. Granular nature and good adsorption characteristics [9] The activated carbon was prepared from apple core and peel with phosphoric acid as an activating agent under microwave irradiation. The effect of microwave radiation strength and time on the absorption capabilities of air conditioners has been studied.

The optimum AC preparation conditions were determined by comparing the adsorption capacities of methyl bromide to the produced activated carbon. The obtained results showed that the microwave radiation strength and time had a strong influence on the adsorption capabilities [(10)].

Hamed studied the effect of the composition of raw materials and preparation methods on the properties of activated charcoal . The record thereof [(11)].

A study was conducted to determine the adsorption rates of the pharmaceutical preparations Amitriptyline and Paracetamol on activated carbon of the type (Carbomix®) and (Norit Ready-To-Use), and a dose of amitriptyline (0.08 g) was added as a fixed dose to all samples. The results of the study showed that the maximum adsorption capacities of Amitriptyline were 0.49 g/g Carbomix® and 0.70 g/g (Norit Ready-To-Use) and that the capacity of Paracetamol was 0.63 g/g Carbomix® and 0.72 g/g(Norit Ready-To-Use)[(12)] .

(Rizhikovs) and his group prepared granular activated carbon from deciduous wood by direct aerobic carbonization and physical activation with steam heating at a temperature of (600°C) [(13)].

Al-Ghanam and his group were able to prepare an activated carbon from tooth wood using an excess of potassium hydroxide at a temperature of (550°C) for a period of 2 hours [(14)].

High surface activated carbon was prepared by chemical activation of Paulownia (Paulownia elongata) wood, using H3PO4, as a chemical activating agent. The chemical activation process was carried out with different impregnation ratios (4-1) and final carbon temperatures (600-300°C). The effect of carbonization temperature and impregnation rate on surface area, pore development and activated carbon yield were studied.

It was found that the effect of the impregnation ratio on the porous structure of activated carbon is stronger than the effect of the final carbonization temperature.

The use of H_3PO_4 is more effective in developing the activated carbon structure. The final carbonization temperature of 400°C and impregnation ratio of (4) was determined to be suitable for producing activated carbon over a high surface area. Carbon pore properties including BET surface area, pore size, pore size distribution and average pore diameter were determined by Nitrogene adsorption, at (77K) [(15)] .

Practical part:

First: Primary carbonization of lead wood The raw material (lead wood):

was taken in its dry natural form, and a preliminary carbonization process was conducted for wood at a temperature of (350 °C) for 3 hours, after which the carbonated material was transferred to the second step.

Second: The final carbonation and activation process in different reactors using potassium hydroxide:

A certain amount of the raw material resulting from the first step was weighed and placed in different reactors and the carbonated material: potassium hydroxide was added to it in proportions (1:1) and then the final carbonization and activation process was carried out at a temperature of (550 °C) for 2 hours, after which the model is cooled to laboratory temperature [16].

Third: Purification of the prepared activated carbon:

The activated carbon is washed several times with distilled water in order to obtain samples free of alkali, then washed with a (10%) solution of hydrochloric acid to remove any trace of ions, then washed with distilled water again until it is confirmed that it is free of acidic traces, dried The form is at a temperature of (110°C),

and it is crushed well and then stored in isolation from air [17].

Fourth: Determination of the effectiveness of the prepared activated carbon:

A. Determination of the internal surface area by adsorption of iodine from its aqueous solution [18]:

This method is one of the quick methods used to determine the internal surface area, and it is expressed in the number of milligrams of iodine adsorbed by one gram of activated carbon, as (1 g) of activated carbon is placed in Conical flask with a capacity of (250 ml), to which (10 ml) of a solution of (5%) hydrochloric acid is added, heated to boiling point for half an hour, then left to cool to laboratory temperature, and it is added to the sample by means of a pipette (100 ml) of a solution Iodine (0.1N) The flask is shaken for half an hour, then the contents of the flask are filtered. The filtrate (20 ml) is discarded at the beginning of the filtration process and the remainder is collected in a clean flask, and 50 mL of the filtrate is transferred to a conical flask of (250 mL) capacity and then crushed. With sodium thiosulfate solution (0.1 N)

The weight of the adsorbed iodine is calculated by the activated carbon model according to the following equation:

X= A-[2.2 x B x ml of thiosulfate solution used] (1)

Where A=N, x 12693 (2)

B=N, x 126.93 (3)

whereas:
X = weight of iodine adsorbed in mg by activated carbon
Standard iodine solution, N = 0.1
Tissue of thiosulfate solution N = 0.1
The iodine number is calculated as follows:
Iodine Number = (X/m) x D (4)
whereas
m = weight of the activated carbon model used,
D = correction factor

B. Determination of the outer surface area by adsorption of methylene blue dye from its solution Aqueous [17]:

The adsorption of methylene blue dye from its aqueous solution indicates the ability of activated carbon to adsorb molecules of high molecular weight.

This method includes placing (0.1 g) of activated carbon in a dry conical flask, adding a known amount of methylene blue dye at a concentration of (20ppm), and placing it in a shaker for 24 hours at laboratory temperature, and in case the color disappears, another amount of dye solution is added. Until an increase of the non-adsorbed dye is reached, then the solution is filtered normally, and then the clear solution is taken and placed in an absorption cell. The absorbance is measured at a wavelength of (665 nm) (the wavelength at which the dye is absorbed), and the concentration of the removed dye is calculated. From its aqueous solution, a standard curve is made by taking different concentrations of the dye solution (25,20,15,10,5ppm), and a graph is drawn between the absorbance and concentration values.

Fifth: Conducting some measurements on the activated carbon models:

A. Measurement of ash content [18]:

(1 g) of activated carbon is placed in a ceramic lid and placed in an electric oven at a temperature of (1000 °C) for 3 hours, then left to cool and then weighed to calculate the weight of the residue that represents the ash. Calculate the percentage of ash.

B. Bulk Density Measurement[19]:

A certain amount of activated carbon is placed in a volumetric bottle of (5ml) capacity, so that the activated carbon occupies the volume of the bottle and is one level up to the mark, after which the present carbon is weighed . The vial using a sensitive balance and the density is calculated:

at
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$$\text{Density gm/cm}^3 = \frac{\text{mass}}{\text{volume}}$$

C. Moisture content measurement[20].
Weigh (1 g) of activated carbon, then place it in the heating oven at a temperature of (150 °C) for three hours. From the weight difference before and after heating, the moisture content is calculated.

Results and discussion:

Activated carbon is a group of carbonaceous materials that have an internal surface area It has a large porous structure and an advanced porosity[21], as it contains pores as well as oxygenated surface groups [22]. Activated carbon differs from other types of carbon in terms of its composition and its huge surface area, which ranges between (>1000 m^2/gm) [23] .
Activated carbon is generally made of all hydrocarbon materials, whether of animal or vegetable origin. Which can be converted into a carbon material and then activated and converted into activated carbon.
The process of transforming and activating all raw materials goes through two main processes, the carbonation process and the activation process to obtain activated carbon, and there are several modifications of these two processes to obtain a high carbon content in the raw material, which is reflected Turn on the properties of activated carbon prepared in the form of baby or powder granular[24].
In our study, reactors made of different materials were used to prepare activated carbon in order to study the effect of the reactor type on the properties of the prepared activated carbon.
Table (1) properties of activated carbon prepared using different reactors

reactor type	iodine number (mg / g)	methylene dye Zarqa (mg / g)	Density (g/cm^3)	Humidity(%)	The ratio Centennial for Ash (%)
resistant iron(rust)	560.01	235.20	0.2058	13.86	19.52

copper	579.56	76.90	0.3776	9.49	10.60
aluminum	506.96	58.50	0.4580	11.82	14.99
pyrex	439.94	36.00	0.4211	8.46	10.26
iron galvanized By chance	398.05	78.80	0.3502	17.25	29.81
pottery	375.71	25.80	0.4625	6.36	14.39

We note from the above table that according to the type of reactors, the results obtained for the effectiveness of activated carbon differed. When using a stainless steel reactor, the value of the iodine number and methylene dye for activated carbon was better than the rest of the results obtained compared with the activated carbon prepared in other reactors, and we believe that this is due to the heat distribution.

The excellent performance of stainless iron metal, and this was confirmed by the high methylene blue dye for activated carbon prepared in this reactor, which reached (235.2 mg / g), where there was a clear improvement in the type of internal pores compared to the values of methylene blue dye for activated carbon prepared in the rest reactors.

The density value of the activated carbon prepared when using the stainless steel reactor was less than the density values of the activated carbon prepared using other reactors. Density value compared with density values for activated carbon prepared using other reactors.

Next in terms of effectiveness is the copper reactor, but the development that took place was in the internal pores, where the value of the iodine number reached (579.8 mg / g), and the methylene dye amounted to (78.9 mg / g), which means that the development in the quality and number of external pores was not at the required level. This directive is supported by the fact that the density of activated carbon prepared in this reactor was (0.3776 g/ cm^3). comes after him in terms of comparing the effectiveness of activated carbon adsorption using several reactors, which is the aluminum reactor. We note that the effectiveness of the prepared activated carbon was only in improving the quality of the internal pores, where the value of the iodine number was (506.96 mg / g), while the external pores represented by the methylene blue dye reached (58.5 mg/g), which is less than in the stainless steel reactor and the copper reactor, and this is clear from the density values that

were (0.4580 g/cm^3), which is one of the two reactors above, meaning that the development in the pores was not good, followed by the Pyrex reactor, where the value of the iodine number reached (439.94 mg /gm), the pores are higher.
The external, represented by the dye methylene blue, reached (8.46 mg/g).
Then comes the tin-galvanized iron reactor, where the value of the iodine number reached (398.05 mg /g), while the external pores represented by methylene blue dye amounted to (78.8 mg /g).
Then came the pottery reactor, where the iodine number reached (439.94 mg / g), and the external pores represented by the methylene blue dye reached (8.46 mg / g).
As for the moisture values, they varied between (17.25 - 6.36) compared with the values of water vapor adsorption, due to the fact that the moisture values differed according to the type of reactor.

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