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STUDY THE SPECIFICATIONS OF ACTIVATED CARBON PREPARED FROM AVOCADO SEEDS USING CARBONATION AND CHEMICAL ACTIVATION

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Abstract

Activated carbon was prepared from Avocado Seeds using different percentages of sodium hydroxide and under the same conditions. Through the study, it was found that increasing the base leads to the production of new good varieties of a neutral nature. The study proved through physical and chemical examinations of the prepared samples that gave the best results when compared with other samples for activated carbon produced by well-known companies, the most important tests conducted for the prepared samples are the determination of the density, the iodine number (IN), the low ash content, the measurement of the external surface area by the adsorption method of the methylene blue dye from its aqueous solution, the measurement of moisture and ash content.

Keywords: Activated Carbon, Avocado Seeds, Carbonation, Chemical Treatment, Adsorption, Methylene Blue Dye, Iodine Adsorption.

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Introduction

Activated carbon is a substance similar to black carbon, and the only difference between them is the small inner surface area of carbon black . Therefore, activated carbon is distinguished by its ability to remove all non-carbon impurities due to its high porosity that distinguishes it from ordinary carbon by containing oxygenic surface compounds[1].There are Two types of activated depending on The size and shapes of the particles: first Granular Activated Carbon, this type is used to adsorb gaseous substances and vapors. It is produced in the form of granules to facilitate the passage or permeation of gases through its layers [2] in addition to its ability to adsorb organic and inorganic pollutants present in low concentrations and dissolved in aqueous solutions such as nitrogen, sulfur and heavy metals left over in sewage and industrial waste water. The seconed type is Powdered Activated Carbon is used to remove colors from aqueous solutions of dyes in textile industries. The use of powdered carbon is more voluntary than granular carbon, as the specifications of the powder can be changed and deal with it more easily for the purpose of obtaining some of the required specifications[3].

Carbon can be prepared from residues of cellulos [4], sawdust [5], wheat husks [6] barley straw [7], walnut husks with little Hammam Al-Alil tar [8], walnut husks with PET residues [9] and phenol-formaldehyde resins [10]. and old tires[11], and since 1974-2000, heavy industrial water wastes have been exploited [12,13,14], where they can be prepared and treated by various methods in order to contain these irregularities on different acids and bases as well as containing activated gases such as steam water, nitrogen or carbon dioxide, and the results and specifications of the produced carbon can be improved by removing moisture, [15] And there are other treatments for the carbon-containing substance, including its treatment with phosphoric acid or zinc chloride [16-17], and the use of industrial waste water to manufacture carbon is considered one of the techniques for treating environmental pollution [15]. At the same time, carbon is prepared by two stages: carbonation and oxidation [18]. The carbonation is the first step in preparing activated carbon, in which carbon is prepared from the raw materials. Carbonation usually occurs by heating raw materials in isolation from air to high temperatures to rid carbon from some of the materials in its composition, which in turn are transformed into volatile materials that are easily disposed of.

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The temperature is preferred between (500-400) °C in the production of carbon [19], where a loss of weight occurs at (750-500) °C by (70-60%) in the form of carbon dioxide and volatile substances, and the carbonation process is followed by an oxidation process and that To prevent the carbon from being malleable to heat during the charring process, which leads to opening the pores where the produced carbon has a small surface area [20].

Practical part

1- The devices used:

A- Spectrophotometer (operating in the visible region).

b- Electric shaker.

C- Electric oven (1000) °C.

D- Stainless steel bowl.

E - Glass desiccator for dryer.

F - Porcelain mortar.

2- Preparation of the raw material:

The avocado seeds were dried and ground to a very fine powder to obtain good results, in order for the interaction between them and the carbonated substance to be as large as possible.

3 Primary carbonization process:

(15) g of Avocado seeds powder was mixed with sodium hydroxide in varying weight ratios of (2:1,1.5:1,1:1,0.5:1) (weight: weight) (Avocado seeds powder: NaOH) using a steel bowl Stainless steel, homogenize the mixture well and heat for 90 minutes at a temperature of (350) °C.

4 Final carbonization process:

With continuous stirring, the temperature is raised to (560) °C for a period of two hours to get rid of gases and vapors completely, then it is removed from the heat source to purify the activated carbon and take measurements.

5- Purification of the prepared activated carbon:

To obtain activated carbon free from sodium hydroxide and metal residues, the prepared activated carbon is washed several times with distilled water and the alkaline substance is removed by continuing washing with distilled water. In order to remove the ions, the washing is done with 25 ml of a solution (10%) of hydrochloric acid, and then it is washed several times with distilled water until the removal of any traces of the acid and to verify this by using litmose paper, the product is dried at 130 ° C and using a porcelain mortar is finely ground and kept in isolation from the air.

6-Determination of the effectiveness of the prepared activated carbon:

A- Measuring the inner surface area using the iodine adsorption method from its aqueous solution:

It is a common method used for the purpose of knowing the internal surface area and expressed as the number of milligrams of iodine adsorbed from the solution by (2) g of the prepared activated carbon, and by applying the equation below(21) the iodine number (I.N.) is calculated:

X / M *D=I.N.

Since:

X: weight of iodine in mg adsorbed by activated carbon.

M: the weight of the activated carbon model used.

D: correction factor

B- Measuring the outer surface area of activated carbon: by measuring the adsorption capacity of methylene blue dye from its aqueous solution: [22]

Put in a conical flask (0.2) g of activated carbon, then add to it (200) ml of methylene blue dye at a concentration of (10 ppm), put in an electric shaker for (24-26) hours at laboratory temperature and add (100) ml of The solution is when the color of the dye disappears and the solution is left until the activated carbon precipitates when the color of the dye is fixed. After that, a quantity of the solution is taken to measure the absorbance at a wavelength of (670nm) Then, different concentrations of methylene blue dye (5,10,15,20 ppm) are taken, and the absorbance of the solution is measured at the above mentioned wavelength (670nm), and between the absor bance and concentration values, a line is drawn [23].

7-Making some measurements on the activated carbon models:

A- Measuring the density of activated carbon:

An amount of the prepared activated carbon is placed in a volumetric flask of (10) ml capacity and the material is gently and thoroughly tamped for the purpose of removing the pores between the molecules so that the activated carbon occupies its volume, noting that the carbon particles are one level at the mark limit, and then the carbon in the flask is weighed with a sensitive balance and the density is calculated as The following [24]:

Density = mass/volume (g/cm3)

B- Measurement of moisture content:

The prepared activated carbon is exposed to the laboratory atmosphere for 26 hours and dried at (140) ^{o} C for three hours, then cooled and weighed. From the difference between the two weights, the percentage of moisture content can be found [25].

C - Calculate the acidity function of activated carbon:

It is taken (20) ml of distilled water is added to (2 g) of activated carbon and shaken for 50 minutes, then filtered and the acidity function of the solution is measured [26].

D- Calculating the percentage of ash:

(2) g of the prepared activated carbon is placed in a porcelain crucible and heated for 60 minutes in an oven at a temperature of (1000) ˚C, after that it is cooled in a desiccater to the laboratory temperature and the remaining weight of the model represents the ash and its percentage is calculated [27].

Results and discussion

The use and preparation of activated carbon goes back to a very long time, and researchers in the eighteenth century discovered the adsorption capacity of activated carbon. Many researchers have invented many and varied methods depending on various sources of carbon such as coal, wood and sometimes bones, and at that time this industry was developed in the United States of America for the purpose of using it to remove odors (and unacceptable taste) [28].

It can be distinguished from ordinary non-activated carbon by its adsorption ability, as the first, i.e activated carbon has a large adsorption capacity for fine particles, while ordinary carbon does not have any ability for adsorption and carbon is classified not based on its form when it is activated, but on the source of its raw material such as animal and vegetable charcoal, coal combustion and others, as stated in the classification (Podvari 1996) [29] .

Many of the carbonate raw materials were selected for the production of activated carbon, especially vegetables, such as harvest residues or bituminous coal, hardwoods, nut shells, sewage waste, and seeds of many fruits in addition to crude oil residues. Despite the vast differences between one method and another in the methods of carbonization and activation methods, the aim is the same, which is to use a chemical with heat to remove hydrogen in the molecule through one method or another.

The mechanism of removal is not understood, and it is desirable in the carbonated material that the synthetic formula of the raw material erodes and pores occur in it, the size of which depends on the nature of the carburized and carbonated material. The use of carbonation by means of elemental sulfur or sulfuric acid has significant disadvantages in terms of polluting the environment and keeping a quantity of sulfur in the chemical formula, which limits its use, especially in medical purposes. In our study, natural avocado seeds were taken, which is characterized by its high content of lignin, which is of a hard nature and high carbon content. The aim of the study was to keep The oxygen groups present in the structural formula are close to the surface oxygen groups which helps adsorption. Indeed, avocado seeds were treated with ratios ranging between (0.5-2) of the carbonated material to one of the raw material. The carbonation process took place in the absence of water and to allow the hydroxyl base. Indeed, it was observed that the raw material melts with the carbonated base at the beginning of the process with gradual heating to 560°C.

Where raw carbon was obtained from primary carbonation, which was purified by water washing and thermal reflex with dilute acid HCl and drying, It was noted that the increase in the proportion of the carbonated substance leads to an increase in the moisture content of the resulting samples, and it is not a research or scientific problem that can be overcome by means of heat in isolation from the air, as for the density, it showed a decrease and fluctuation in some times, When studying the adsorption capacity of iodine from its aqueous solution, which reflects the internal surface area, a noticeable increase in the adsorption of iodine from its aqueous solution appeared with the increase in the proportion of the carbonated substance, the same applies to the adsorption of methylene blue dye from its aqueous solution, which ranged from 36.8 to 221.4 from its aqueous solution, which expresses the external surface area of activated carbon, and thus it outperformed the commercial samples, as for the ash content, it was within the permissible percentages from a scientific and commercial point of view. This can be seen from Table No. (1) and the attached figures and diagrams.

Table (1) Properties of activated carbon prepared with modified carbonation and chemical treatment

Sample	Avocado seeds NaOH	Iodine No. (mg/gm)	Methylene Blue (mg/gm)	Ash (%)	Humidiy (%)	Density gm/cm^3
S(1)	1:0.5	973.0	36.8	0.52	6.8	0.13
S(2)	1:1	975.0	65.6	0.8	8.2	0.08
S(3)	1:1.5	1087.0	83.7	0. 9	9.2	0.07
S(4)	1:2	1148.0	221.4	1.2	12.4	0.09
B.D.H.		909	92	3.4	0.9	0.328

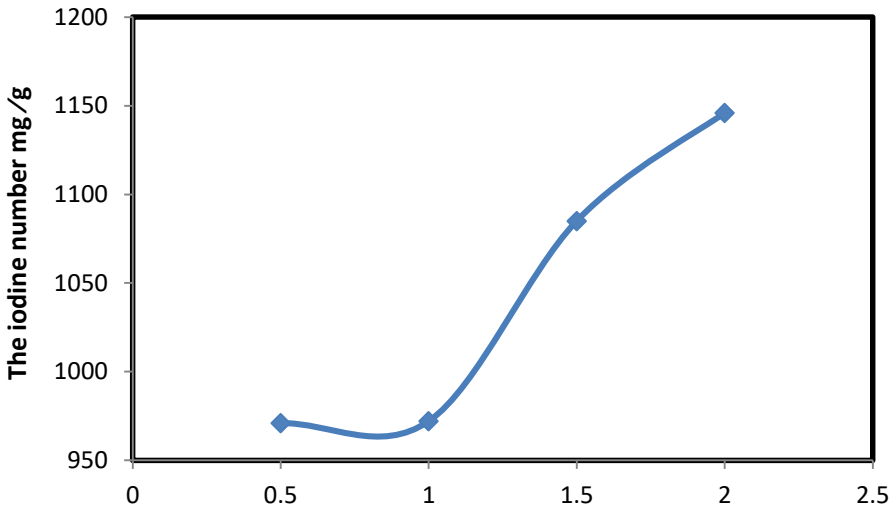


Fig. (1):The relationship between the added (NaOH)ratio and the iodine number

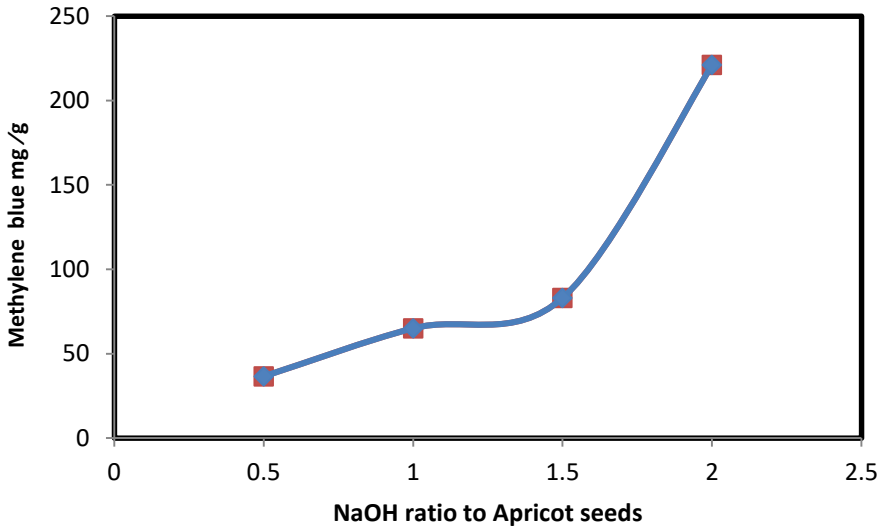


Fig. (2):The relationship between the added (NaOH) ratio and the Methylene blue

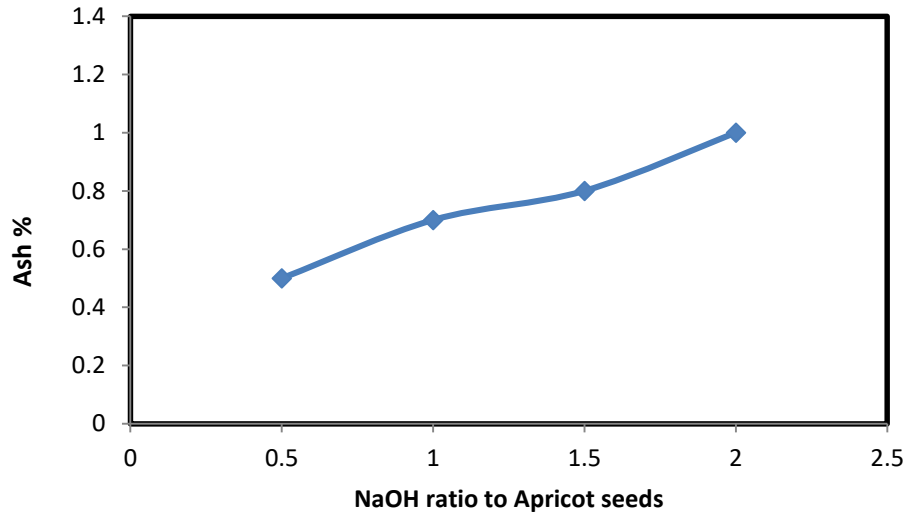
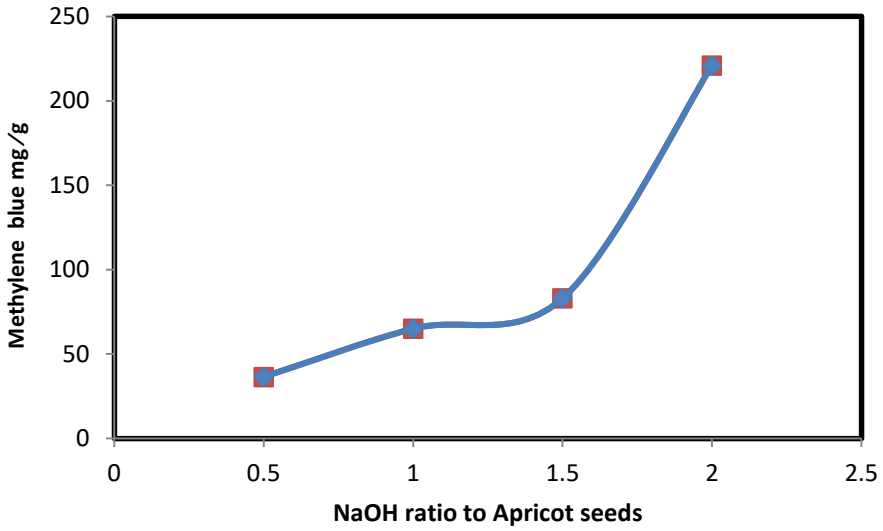


Fig. (3):The relationship between the added (NaOH) ratio With Ash content in activated carbon



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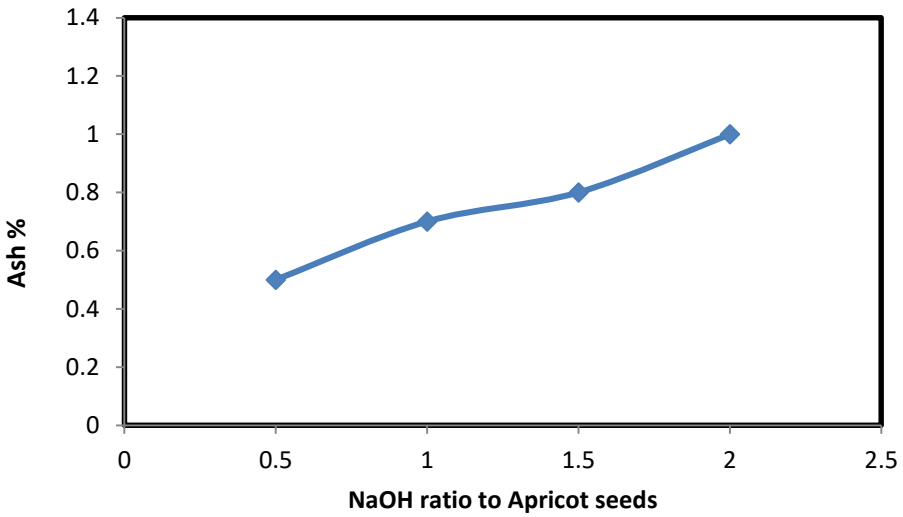

Fig. (3):The relationship between the added (NaOH) ratio With Ash content in activated carbon

Conclusion

Through this research, the possibility of converting avocado seeds into materials of economic value and has multiple uses in application and research has been reached, where the study proved that the activated carbon prepared from avocado seeds with sodium hydroxide as charred materials has a high efficiency that approaches or may exceed the activated carbon produced from global sources. These results were obtained by comparing the adsorption results of methylene blue, and calculating the iodine number for each of the prepared activated carbon samples and comparing it with the activated carbon of BDH and avocado seeds in this research.

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