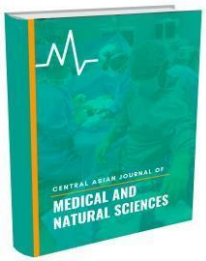

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Article

Preparation of Activated Carbon used in Hydrogenation Processes and Finding The Acid Function and Iodine Number

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Abstract: Activated carbon was prepared from the initial carbonization process, and then the prepared materials were reactivated using the heat activation process by microwave heating and using a 600 watt furnace for 20 minutes. The acid function of the prepared carbon (asphalt) was measured and six samples were taken from the prepared solution and the highest acid function was for the C5 sample and it was equal to 6 This indicates that the prepared carbon is of an acidic type. The iodine number was used from the important tests that determine the adsorption efficiency of the prepared carbon to small molecules, and the table shows that the iodine number gradually increases with the increase in the amount of foam, and the iodine number reached its peak in the sample C3 equal to 865, and the C4 number is equal to 645.

Keywords: Activated Carbon, Hydrogenation, Foam, Carbonated

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1. Introduction

Carbon has long been known as coal [1], as large quantities of it were produced in the seventeenth and eighteenth centuries from plant sources [2], and it was used for various purposes in various fields that require energy [3], such as heating and cooking food [4]. It was used in the sugar palace to remove colors from it, in the manufacture of electrodes [5], as a catalyst, and as a raw material for the preparation of adsorbent in the form of activated carbon. The uses of activated carbon in adsorption processes have developed as follows [6]:

- Chlorination since 1936
- Taste and odor removal since 1955
- Removal of decomposing organic matter since 1970
- Biofiltration since 1970

In the past, activated carbon was prepared from coconut shells [7]. However, the increase in demand has prompted manufacturers to manufacture it from other organic materials such as coal, coal tar, miscellaneous wood [8], polymers, bitumen, asphalt materials, and other materials [9].

We can take the most important types of activated carbon mainly, which are [10]:

A. Activated carbon in the form of molecular sieves

These types are in the form of molecular sieves that contain a high percentage of small pores compared to other pores, and are used in gas separation systems at room temperature, such as the separation of nitrogen and oxygen gas [11].

B. Activated Carbon Fiber

This variety of development of the non-crystalline structure of the raw material (e.g., rayon, bitumen, phenolic polymers, resins), is prepared at 800 °C, followed by steam activation at 1000 °C, giving it a very high surface area of up to 2500 cm^2/g [12]. Due to this high surface area, activated carbon fibers are superior to granular activated carbon in terms of the number of advantages and the large physical area [13].

Molecular and crystal structure of activated carbon

The molecular and crystal structures of both activated carbon and graphite are similar in terms of the number of layers [14], as each layer consists of overlapping hexagonal rings [15], and the distance between the layers is between 3.34 and 3.35 ankstrom, as shown in Figure 1-5. Several studies have shown that activated carbon is irregular (non-crystalline) due to the difference in the length of the bonds on the crystal surface [16], which leads to its collapse during the activation process under extreme conditions that cause bond breakage, thus switching from a regular crystalline state to a non-crystalline state, and produces an active compound containing porous structures with a large surface area [17].

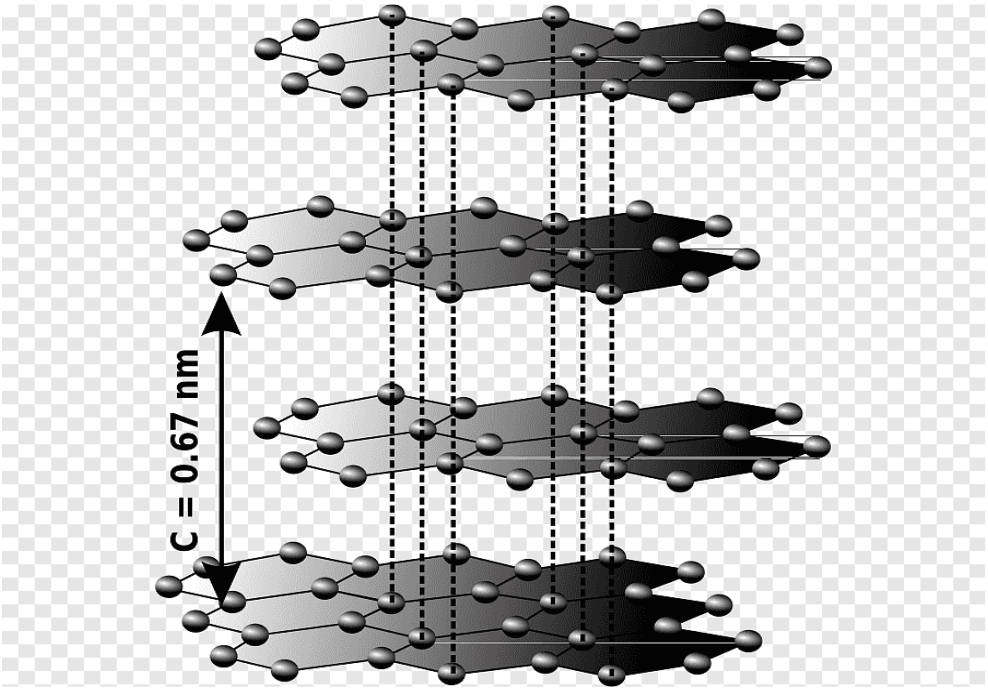

Figure 1. Shows the composition of the graphite

Manufacturing of Activated Carbon

Activated carbon can be synthesized by pyrolysis of carbonate materials from plants such as wood, charcoal, peat, solid fruit casings [18], or polymers manufactured such as rayon, polyacrylonitrile [19], and phenolic resins. Activated carbon manufacturing processes primarily involve raw material selection [20], carbonization process, and activation [21].

2. Materials and Methods

The following table shows the characteristics of a number of materials (raw) used in the manufacture of activated carbon.

Table 1. Characteristics and Properties of Activated Carbon Based on Raw Materials

Structure of activated carbon	Ash content (%)	Density (g/cm³)	Flying Materials %	Carbon content (%)	Raw Material
Soft, large porous volume	1.1-0.4	0.7-0. 6	68-58	55-48	Softwood
Soft, large porous volume	1.2-0.2	0.76-0. 6	60-53	40-35	Coal Steel
Soft, large porous volume	-	0.4-0.3	60-55	38-32	Elkenin
Solid, large porous size	0.6-0.5	1.55	56-53	48-43	Coconut Wrappers
Solid, small porous size	6-5	1.35-1.0	25-40	68-53	Liknit
Average hardness and pore size	2.12	1.50-1.25	34-22	83-66	Soft charcoal
Average hardness and pore size	0.7-0.5	1.35	20-15	85-70	Coke Oil
Solid, large porous size	15-5	1.45	15-1	75-70	Semi-solid coal
Solid, large porous size	2.15	2.0-1.5	10-5	95-85	Coal Steel

Preparation of activated carbon

The material resulting from the initial carbonization process was crushed and partially ground and then sieved with 30 and 40 mash sieves before the activation carbonization was carried out, and then the coal formed from the primary carbonization was activated by steam by placing it in a tubular furnace and raising the temperature of the tubular furnace to 700 ° C for 5 hours while continuing to pump steam into the tube, and then the furnace is extinguished and the tube is left inside it until it cools, then the tube is pulled out after it cools down as in the following figure:

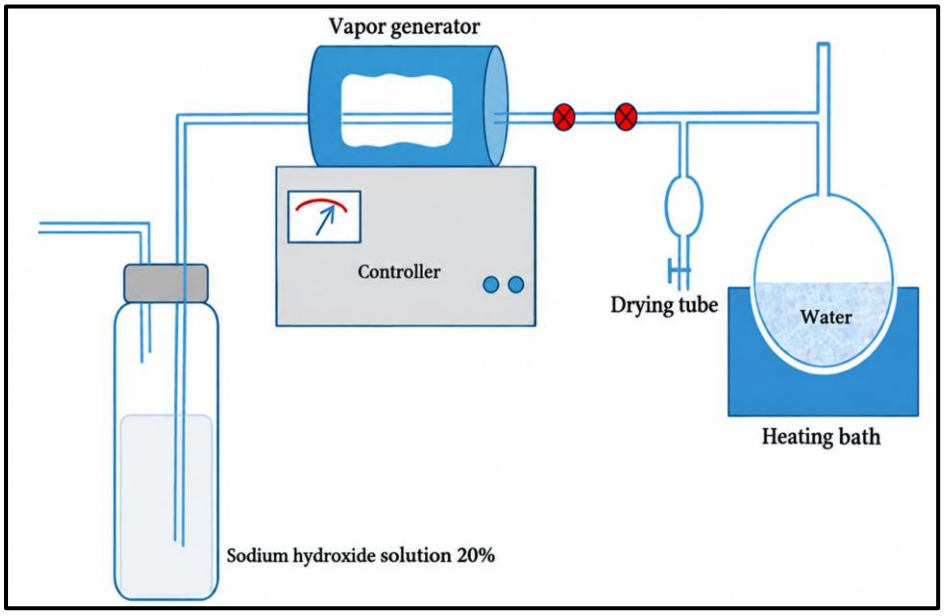

Figure 2. Carbonated Activation and Carbonization Device

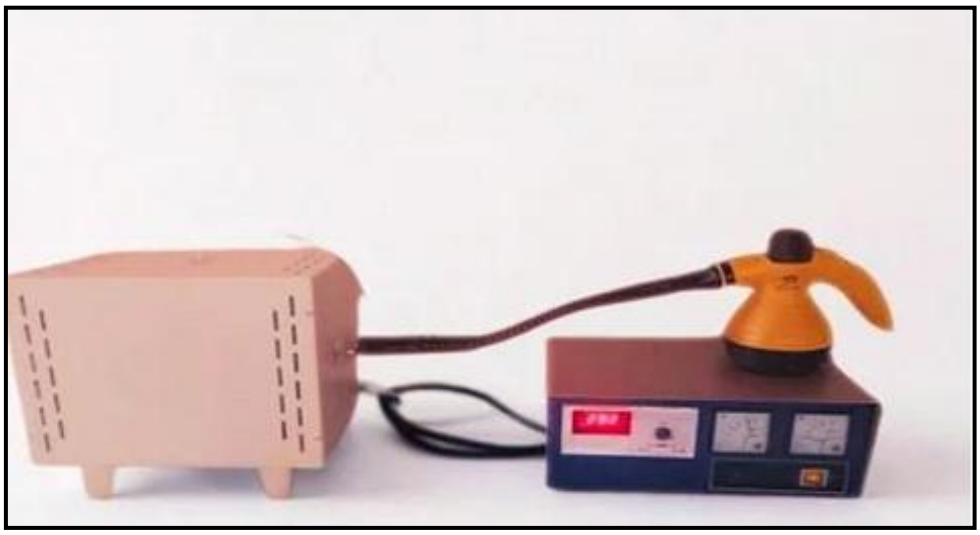

Figure 3. Carbonated Activation and Carbonization Device

The following figure is the carbonated activation and carbonization device.

Thus [22], the activated carbon is obtained as shown in the following figure and then the carbon toll is calculated [23].

$$\text{Activated Carbon Yield \%} = \frac{\text{Weight of Activated Carbon Output (g)}}{\text{Weight of raw material used (g)}} \times 100$$

Figure 4. Showing activated carbon

Microwave Oven Activations

The prepared materials were reactivated using the process of thermal activation by microwave heating. The models were placed in a baker and placed in an oven using (600 watts) power for (20) minutes, after which the models were cooled to a temperature of 25 °C.

Effect of Acid Function

Half a gram of activated carbon is taken and (5**)** ml of distilled water is added to it, shaken for half an hour, then filtered and then the acidic function of the solution is measured.

Specification of the Acid Function of Prepared Activated Carbon

Table 2. Effect of Acidic Function and Foam Addition on Asphalt Content in Different Models

Acidic function	Amount of foam added by gram	Amount of asphalt in grams	Models
4	15	100	C1
4.65	30	100	$_2$C
5	45	001	$_3$C
5.88	60	100	$_4$C
6	75	100	5C
3.44	90	100	C6

3. Results and Discussion

The aim of this study was to evaluate the effect of foam additive on the physical, chemical and adsorption properties of the resulting carbon [24]. The characteristics included testing the acid function, iodine number, andiodine number was used as one of the important tests that determine the efficiency of the adsorption of prepared carbon to small molecules, and thus it can be considered as a function of the amount of pores present in the carbon model The following table shows that the iodine number gradually increases with the amount of foam increasing to a certain extent, indicating an increase in the fine porosity within the crystal structure of the prepared activated carbon [25], and the iodine number peaked in the sample C3 = 865 and C4 = 645. This indicates a strong reaction that leads to saturation and stability in the chemical structure. Before the preparation of the activated carbon, the resulting material was crushed and sifted with 30 and 40 Mash sieves, and then the steamed carbon was activated by placing it in a tubular oven, where the temperature of the tubular oven was raised to 700 $^{\circ}$ C and for 5 years. Hours with the continuous pumping of steam into the tube, and then the pipe is pulled after it cools, and thus the activated carbon is obtained and the result of the activated carbon is taken [26].

Specification of the iodine number for the prepared activated carbon

Table 3. Effect of Foam Addition on Iodine Number and Asphalt Content of Activated Carbon in Different Models

Mg/gm Iodine Number	Amount of foam added in gram	Amount of asphalt in grams	Models
160	15	100	C1
340	30	100	$_2$C
865	45	100	$_3$C
645	60	100	$_4$C
543	75	100	5C
519	90	100	C6

As we can see from the table of the acid function, it indicates that the prepared activated carbon is of the acidic type.

Purpose of the research

1. Preparation of activated carbon used in the hydrogenation process.
2. To study the effect of microwave activation on the improvement of activated carbon properties.
3. Study of the effect of the acidic function on activated carbon.
4. Study of the effect of iodine number on activated carbon.

4. Conclusion

The activated carbon was successfully synthesized, and its carbon yield was determined for assessing the efficiency of the synthesis process. According to the acid function test, the activated carbon synthesized showed acidic nature on its surface. The activation of the activated carbon took place by using steam activation process in a tubular furnace. Iodine number is one of the most important parameters for determining the adsorption capacity of the activated carbon towards small molecules. In addition to that, the iodine number gradually increased with the increase in foam content to a certain extent, which means the fine pore development in the activated carbon.

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