Applied Mechanics and Materials Vol. 467 (2014) pp 49-51
Online available since 2013/Dec/06 at www.scientific.net

doi:10.4028/www.scientific.net/AMM.467.49

Applications of Activated Carbon Sorbents Based on Greek Walnut

Azat S. [1], Rosa Busquets[2], Pavlenko V.V[1], Kerimkulova A.R[1], Raymond L.D. Whitby[2], Mansurov Z.A[1]

[1]Institute of Combustion Problems, Almaty, Kazakhstan

[2]School of Pharmacy and Biomolecular Sciences, University of Brighton,Brighton,UK

seytkhan.azat@gmail.com

Keywords: Activated carbon; Porous carbon; Chemical activation; Physical activation; Surface area.

Abstract. This article presents the results of the synthesis of carbon nanomaterials: Nanoscale materials obtained by carbonization of waste agricultural products (apricot kernel, Greek walnut(GW), rice husk). The results of physico-chemical characteristics of the obtained nanomaterials. Physico-chemical parameters of the synthesis of carbonized sorbents based on plant raw material are investigated along with the properties of these sorbents. The data of FTIR, ESR spectroscopy & BET- method, as well as electron microscopy are reported. It is stated that carbonized sorbents possess high specific surface area and porosity. Carboxylic, carbonyl, hydroxyl groups are detected on the surface of the synthesized sorbents. Separate fusicoccine and similar biostimulators effectively; remove LPS-endotoxines from blood plasma selectively. They may be used as carriers to introduce probiotics into intestine thanks to formation of stable colonies on their developed surface. A method of preparation of honeycomb monoliths from carbonized rice husk with developed mesoporous structure via modification of the porous structure by silica leaching has been developed.

Introduction

Carbon materials are unique and versatile in their performance. They have major industrial significance. Activated carbon materials characterized by high specific surface area and tunable porosity find utility in many vital technologies namely energy storage (super capacitors, batteries, hydrogen sorption), energy conversion (fuel cells, solar cells), sensors, environmental protection (regulate SO_x and NO_x emissions from fuel combustion in automobiles), production of fine and bulk chemicals and catalysis[1].

Activated carbon is a material with highly porosity consisting of hydrophobic grapheme layer as well as hydrophilic surface functional groups making them beneficial for sorption and catalytic applications[2]. Specific industrial applications include areas such as oil and natural gas, food, pharmaceuticals, water treatment, hydro metallurgy, gold recovery and carbon - in – pulp process. Activated carbon materials are effective in removing pollutants (both gaseous and liquid). The advantage of activated carbon materials as adsorbents is that the treated effluent is of highly quality, the design of the process is simple, the operation of the process developed or adopted is easy. In addition carbon materials are resistant to corrosive(acidic and basic) and toxic environments. In addition to purification of gases and liquids with high adsorption potential, activated carbon materials are also used as catalysts and catalyst supports. Carbon materials play an indispensable role in almost all electrochemical devices, to name are few, batteries, supercapacitors, and fuel cells. The choice carbon as the material is because of its unique properties of electrical conductivity and structural diversity[3]..

Experimental work

In a series of experiments on the physical and chemical activation samples walnut. Physical activation of the samples was carried out in a rotating walnut made of a stainless steel reactor. As activating agent chosen gaseous carbon dioxide which is supplied from bubbler into the reaction

zone at a rate of 50 cm^3/min. For the experiment, crushed walnut shells, highlighting the sifting of the products of crushing the working fraction with a diameter of 2-4 mm[4].

Chemical activation of the GW samples was impregnated with 80% walnut phosphoric acid in various proportions and carbonized at 160° C for 12 hours in muffle furnace. The resulting mixture was subjected to pyrolysis in beaker placed in a muffle furnace at 500°C. Carbonized GW samples walnut washed by boiling in distilled water until neutral pH.

The specific surface area was determined by thermal desorption of argon, developed by Nelson and Egertsonom.

X-ray structural analysis of the elemental composition was determined by the original samples walnut and walnut samples, which were activated with CO_2 and H_3PO_4 measurement results are shown in Table 1

Table.1. The results of elemental analysis of samples walnut

The temperature carbonization, the activating agent	C, %	O_2, %	Si, %	Mg, %	S, %	K, %	P, %	Ca, %	Al, %
Original walnut	57,54	39,5	0,60	0,16	0,98	0,80	-	1,62	-
500 °C, H_3PO_4	88,84	7,23	-	-	-	-	3,93	-	-
1000 °C, CO_2	81,11	12,89	0,59	0,57	0,05	1,72	-	3,71	-

The main weight loss occurs in the range 150-500 ° C, while heating from 100 to 250 ° C released the greatest amount of volatile substances.

The method of thermal desorption of surface area was found samples obtained by physical activation in the presence of CO_2 (activation time 1 hour), as well as samples obtained by chemical activation using H_3PO_4, research results are shown in Tables 2 and 3.

Table.2. The results of physical activation samples GW in the presence of CO2

Temperature carbonization, °C	600	700	800	900	1000	1080
S_{BET} (Ar) $м_2$/g	210	337,50	309,10	265,10	198,15	249,20

Table.3. The results of chemical activation samples GW phosphoric acid

Temperature carbonization, °C	Impregnation ratioH_3PO_4/ walnut	Time carbonization, h	S_{BET} (Ar) $м_2$/g
500	2:1	1	1000

As evidenced by the experimental data, the optimal duration of the heat treatment in all cases the same, and is 1 hour. By IR spectroscopy in the original sample GW found intense bands corresponding to the characteristic absorption bands of the carbonyl group, but they disappeared at an elevated temperature of carbonization between 500 - 900 ° C. Carbonyl groups can be lost with the release of CO_2. The Initial sample GW was characterized by intense bands corresponding to the cellulose. As the carbonization temperature increased, these bands decreased in intensity, and ultimately they disappear.

On a mercury porosimeter (Quantachrome PoreMaster), the total volume was determined as a function of applied pressure on measurements intrusion / extrusion mercury. Smooth change of pressure (up to 2000 pixels) provides detailed data on the precise pore size using the automatic regulation of the rate of changhe e of pressure, taking into account features of the material. Results of the porosimeter data are presented in Figure 1.

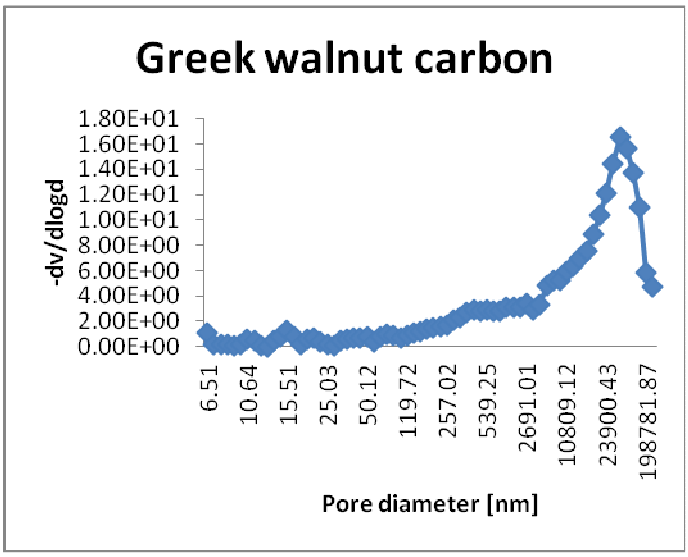

Figure.1. Pore size distribution of GWcarbon.

In accordance with the obtained results, the resulting carbon sorbent has a highly porous structure and a set of cells and voids.

Separation of liquids containing high-molecular substances having a large molecular size requires a sufficiently large pore diameter on the surface of the sorbent. Thus it can be assumed that the samples obtained by carbonizing GW having a sufficiently wide macropores (>1micron) and the large specific surface area(>1000 cm^2/g) may contain a sufficient quantity of such high-molecular substances and provide durable and at the same time cheap sorbents for different needs.

Conclusions

1. Carbon obtained by carbonization samples have well-developed morphology and high specific surface area.

2. Samples obtained in the presence of activated CO_2 and H_3PO_4, even at high temperatures retain mechanical strength.

3. The study of the carbonized samples showed the presence of oxygen containing groups on the surface, indicating high potential for ion exchange applications and their use in polar media.

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Materials Science and Mechanical Engineering
10.4028/www.scientific.net/AMM.467

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