Studying the sorption properties of adsorbents obtained on the basis of plant waste

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Abstract. In Uzbekistan theoretical and practical results are being achieved in the creation of adsorbents with a high sorption capacity based on natural resources, in particular plant waste, and their adsorption purification from residues of organic substances that are part of wastewater. The characteristics of the prepared carbon sorbent obtained on the basis of some optimal formulations using small samples of charcoal obtained from activated walnut and almond pods using an iodine composition were studied. The objects of the study were walnut and almond shells. The results of analyses for checking the adsorption activity of coal for iodine and determining the number of moles are presented in the form of a table.

1 Introduction

Currently, one of the major and global problems is the treatment of wastewater from organic industrial waste. The solution to this problem is the production of environmentally friendly adsorbents based on plant raw materials. The increasing use of natural resources, biomass recovery, and biomass waste in the past decade, has attracted the attention of an increasing number of scientists [1].

Biomass nutshell is a large-yield crop remains that is commonly discarded or incinerated. Not only pollutes the environment but also wastes a large number of resources. To avoid this, many scientists have initiated research into its potential uses, including the use of biomass nut shells to produce activated carbon.

Activated carbon is a modification of carbon raw material particles, microcrystalline transformation results in a micro-, meso- and macroporous sorbent product with a high carbon content [2]. Carbon particles 1-3 nm in diameter ha and 2-3 nm in length equal to consist of crystallites. According to the data of X-ray analyses presented in various literature sources, the distance between the planes of carbon networks is 0.354 nm. In activated carbon microcrystals, the distance between the graphitic carbon lattice planes is 0.342-0.414 nm, and the height is 1.0-1.3 nm [3].

To sustainably use natural resources, biomass waste processing has become significant. In addition, renewable biomass waste has been proven to be a promising discovery for new carbon-sequestering materials. Due to the high density of oxygen functional groups and the

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low degree of condensation, biomass waste is directed to the production of carbon materials with the desired properties for various processes. In particular, activated carbon from biomass waste is widely used in many fields as an adsorbent, supercapacitor, oil-water separation, and resource extraction [4].

In general, walnut is one of the most valuable food products, and their caloric content and nutritional value are higher than meat, bread, eggs, and other food products. In the process of obtaining kernel or high-quality oil from walnuts, a large amount of walnut husks is produced as waste [5], in turn, the problem of rational use of this plant waste arises. Therefore, the walnut shell is a cheap secondary raw material.

2 Materials and methods

In this study, different pyrolysis temperatures were investigated to obtain carbon adsorbents based on local plant waste, walnut, and almond husks.

A large amount of almond shells are disposed of every year. In total, the world produces 4.14 million tons of almonds per year. These are the statistics for 2020. Weight, in this case, is considered together with the shell.

Almonds are a type of biomass nut shell and are widely grown in many regions of the world. The undisputed world leader in the cultivation of almonds is the United States of America. 2.37 million tons per year, which is 57.2% of world production. The top thirty includes the Central Asian republics: Uzbekistan, Tajikistan, and Kyrgyzstan [6]. The almond barks used in this study were purchased from Chortok village (Namangan, Uzbekistan). Almond shells have well-developed pore structure. The elements of almond shells include C (72.27%), O (22.88%), N (3.87%), and Si (0.87%). The main chemical constituents of cellulose, hemicellulose, and lignin account for 38.48%, 28.82% and 29.54% [7].

The walnut barks used in this study were purchased from Chortok village (Namangan, Uzbekistan). It is known that walnuts are the most valuable food product, which surpasses meat, bread, eggs, cow's cream, and others in terms of calorie content, nutritional value, and digestibility. When processing a walnut into kernels or high-quality oil, a walnut shell is formed as a waste, averaging 51–59% of the weight of the nut itself, which must be disposed of, preferably with the production of valuable and useful products. At the same time, the problem of rational use of walnut processing waste is solved, and at the same time, they are secondary raw materials of low cost. It is known that walnuts are the most valuable food product, which surpasses meat, bread, eggs, cow's cream, and others in terms of calorie content, nutritional value, and digestibility. When processing a walnut into kernels or high-quality oil, a walnut shell is formed as a waste, averaging 51–59% of the weight of the nut itself, which must be disposed of, preferably with the production of valuable and useful products. At the same time, the problem of rational use of walnut processing waste is solved, and at the same time, they are secondary raw materials of low cost. [8]

a b c

Fig. 1. Almond shell optical pictures.

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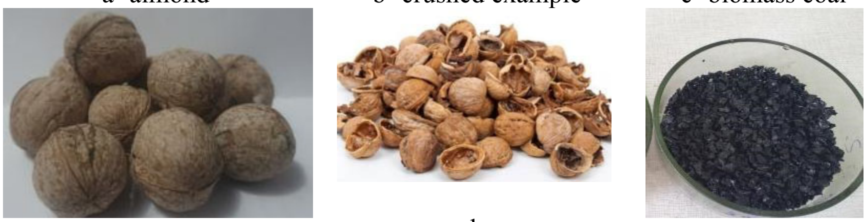
a- almond b- crushed example c- biomass coal



a b c

a- walnut b- crushed example c- biomass coal

Fig. 2. Walnut shell optical pictures.

3 Results and discussion

In total, the world produces 4.14 million tons of almonds per year. These are the statistics for 2020. Weight, in this case, is considered together with the shell.

As you know, the production process of charcoal is quite simple: it is burned in a closed space, without air access, by pyrolysis. At high heat from wood turns out: charcoal, as well as liquid and gaseous products (Auston, methanol, acetic acid, resin, etc.). But despite all simplicity, the pyrolysis process must be carefully controlled. Otherwise, the amount of the resulting charcoal seems to be less, and the coal itself will be fine and smell like resin.

According to the results of the research, thermal pyrolysis of the walnut shell powder (WSP) and almond shell powder (ASP) samples based on the ash content, and sorption parameters of benzene vapor as a result of the study of adsorption properties 500 ^{0}C and 800 ^{0}C temperatures were chosen as the optimal mode.

For testing, 50% NaOH solution in a 1:2 ratio of modified (M- WSP, M- ASP) and pyrolyzed (WSP and ASP) samples are dried in a 150 cm^3 oven at a temperature of (105 ± 5) °C for 1 hour. It is allowed to test models only after drying the coal moisture content of not more than 3%. The dried coal was passed through a vibrating control sieve No. 10 for 3 minutes. If the charcoal prepared for testing is not used immediately, it should be stored in a hermetically sealed desiccator container in a dryer [9-11].

Using a measuring cylinder, samples of modified and pyrolyzed YPC and BPC coal were taken, 50 cm3 each, and the outer surface of the cylinder was hit with a rubber hammer until the coal stopped settling. Then the coal sample was weighed (the weighing result is recorded to the second decimal place).

To transfer experience, it is necessary to prepare a solution of iodine according to GOST 4159. Measuring 25 g of potassium iodide per flask with a volume of 50-100 cm^3 add distilled water and 12.7 g of iodine, the flask is stirred until the iodine is completely dissolved. After that, the volumetric flask is filled to the mark with distilled water.

The cylinders of the sk-l330-pro center with the orbital mixer of the apparatus are transversely released from the racks, the plug opens and the steel balls are issued. Half of the samples of the plugs and three steel balls are placed in the cylinder, caution is installed on the cylinder, the samples of the second half are filled, and the plug of the cylinder neck is installed transversely with the help of closed hardware across the pillars between them. The same order is repeated with secondly the cylinder. The device itself and the stopwatch will turn on for 10 minutes after the device is removed. The cylinder of hardware was removed from the poles, the cylinder contained substances Control No. 10 on the sieve is carried out.

Fig. 3. Working solution and adsorbent samples.

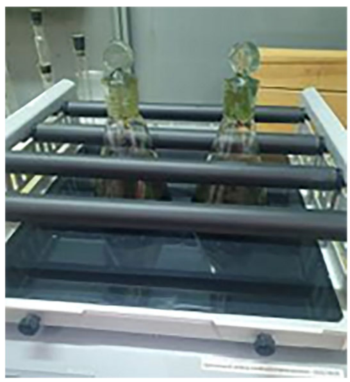


Fig. 4. SK-l330-pro is equipped with an orbital line mixer.

Modification and pyrolyzed WSP and ASP coal have been sieved vibration frequency are 3 minutes. Sieve conducted content is weighted (gravity result second to the decimal point is written). Just like a model in the second cylinder with is repeated. To dishes put samples in the order worker solution $Na_2S_2O_3 \cdot 5N_2O$ drips and results note by doing will go Indicator as A 0.5 % starch solution is used. Control coal samples are BAU and India were used.

Defining the adsorption activity X, %,

$$X=\frac{(V_1-V)*0,0127*50*100}{10*m}$$

where V_1 is the volume of a solution of sodium thiosulfate with a concentration of 0.1 mol/dm^3 (0.1 N) used to titrate 10 cm^3 of a solution of iodine in potassium iodide, cm^3;

V is the volume of a solution of sodium thiosulfate with a concentration of 0.1 mol/dm3 (0.1 N) used for titration of 10 cm^3 of a solution of iodine in potassium iodide, after treatment with coal, cm^3;

0.0127 is the mass of iodine corresponding to 1 cm^3 of a solution of sodium thiosulfate with a concentration 0.1 mol/dm^3 (0.1 N), g;

100 is the volume of a solution of iodine in potassium iodide, taken for clarification with coal, cm^3;

50- is the weight of the coal sample, g.

m - experience for received coal of the sample weight, g.

The table (Table 1) describe the results tested against the samples.

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Table 1. Results of calculating the adsorption degree.

No	Sample	Samples iodine according to adsorption level, %
1	WSP	25%
2	ASP	19%
3	M - WSP(modified)	67%
4	M -ASP (modified)	66%
5	BAU	32.75%
6	INDIA	77.6%

4 Conclusions

According to the table, it can be concluded that compared with the adsorbent obtained from the pods of pyrolyzed walnuts and almonds, samples of walnuts and almonds modified with 50% NaOH solution in a ratio of 1:2 absorbed iodine well. Compared with the India sample, M-WSP differed by 10%, and M-ASP by 11%. BAU showed an advantage of almost 33% compared to the control sample.

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