RESEARCH OF TECHNICAL CHARACTERISTICS OF COAL SORBENT GS-1.

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Abstract: *Carbon sorbent GS-1 from cation exchanger KU-2-8. KU-2-8 was soaked in a 6% hydrochloric acid solution and dried at a temperature from 110°C to 120°C. The dried product was cooled to room temperature and placed in a muffle furnace for heat treatment in an inert atmosphere, the process was carried out at a rate of temperature increase from 40°C to 500°C, kept at 500°C for 2 hours, and cooled to room temperature in an inert atmosphere. Cleaning of dust and resins on the surface of the obtained sorbent, i.e., the activation process, was carried out in an inert atmosphere at a temperature of 550–650 °C in the presence of water vapor.*

Keywords: *Carbon sorbent GS-1, heat treatment, inert atmosphere, SEM imaging, elemental analysis, thermo gravimetric analysis (TGA), activation, average granule size.*

Introduction: All over the world, scientific research is being carried out to develop a technology for the production of activated carbon sorbents based on secondary polymers. In this regard, special attention is paid to the production of strong carbon sorbents that are biologically suitable for the purification of blood plasma from toxic viral substances, the production of sorbents for the treatment of wastewater in the chemical industry, as well as the production of activated carbon sorbents of high strength and low degree of use. With the creation of sorbents of various nature and structure for the removal of toxins, medical sorption arose [1].

The processing of initial products with chemicals made it possible to obtain porous activated carbon sorbents that can be used in medicine [2].

The use of sorbent materials in medicine has prompted the study of sorption processes, the creation of new types of sorbents, and the creation of sorbents that do not lose their strength when exposed to biological fluids. Activated carbon sorbents combine medical sorbents with unique properties into a single class. They do not adversely affect the composition of normal biological fluids due to the stability of the absorption properties [3].

Sorbents can be divided into two groups depending on the type of use: 1-neutral sorbents (silica gels and neutral copolymers without ionic groups); 2 - ion-exchange sorbents (organic and inorganic synthetic mineral ion-exchange sorbents) [4.5]. The most important disadvantages of sorbents obtained on the basis of natural raw materials are low strength and high ash content [6; 7; 8; 9; 10].

Sorbents based on natural raw materials, such as wood (BAU), peat (SKT-6A), coal mixtures, do not meet medical requirements [11].

At present, the sorbents used in medicine are chemically pure solid sorbents with their own characteristics [12; 13.].

The most commonly used sorbents in medicine: in medical practice, sorbents based on polymers (SKN, SUGS, FAS, SKS, Simplex), carbon-mineral sorbent (SUMS-) are used [14]. The use of

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polymer raw materials for the production of sorbents for activated carbon used in medicine makes it possible to obtain durable sorbents. Synthetic ion exchange resins have a fixed composition. Activated carbon sorbents synthesized for medical purposes are also used to regulate the water-salt balance of toxins in biological fluids and to remove radioisotopes. An increase in the production of polymeric materials made it possible to obtain activated carbon sorbents based on them with a chemical composition, pore size and surface functional groups for medical purposes. Synthetic ion exchange resins are solid granules containing ionic groups. In the USA, England, Germany and other foreign countries, sorbents based on polymeric resins KU-2, AV-17, AN-22, MKhTI-2K, SF-5, and SFN have been obtained. Granular synthetic sorbents "BAC" are produced in Japan. The Japanese company Asahi Kasei Kuraray Medical today produces synthetic sorbents for plasmapheresis Plasorba BR, Immusorba, Adacolumn. "Plasorba BR-350" - synthetic sorbents based on copolymers of styrene and divinylbenzene, "Adacolon" - based on cellulose, "Immunosorb RN-350" - sorbents based on agarose. In the USA, hemosorbent "Ambersorb" was obtained in the form of granules, which practically does not form ash in sorbents obtained on the basis of polymeric materials [15].

The impetus was the use of sorbent materials in medicine, the study of sorption processes, the creation of new types of sorbents, and the creation of sorbents that do not lose their stability when interacting with biological fluids. The properties of activated carbon sorbents are evaluated according to a number of criteria. Determine the adsorption capacity, chemical purity, surface morphology, the absence of mechanical impurities, the mechanical strength of the granules, the absence of dust formation in contact with the biological environment, sterility, non-toxicity. The properties of activated carbon sorbents have been evaluated by experimental methods. Direct observation methods are used in the study of morphology. Morphology is studied in a scanning electron microscope [16].

EXPERIMENTAL PART:

Method for producing carbon sorbent GS-1 from cation exchanger KU-2-8. KU-2-8 was soaked in a 6% hydrochloric acid solution and dried at a temperature from 110°C to 120°C. The dried product was cooled to room temperature and placed in a muffle furnace for heat treatment in an inert atmosphere, the process was carried out at a rate of temperature increase from 40°C to 500°C, kept at 500°C for 2 hours, and cooled to room temperature in an inert atmosphere. Cleaning of dust and resins on the surface of the obtained sorbent, i.e., the activation process, was carried out in an inert atmosphere at a temperature of 550–650 °C in the presence of water vapor.

RESULT AND ITS DISCUSSION: The resulting activated carbon sorbent grade GS-1 was examined on a MIRA 2 LMU scanning electron microscope equipped with an INCA Energy 350 energy-dispersive microanalysis system. The resolution of the microscope is 1 nm, and the sensitivity of the INCA Energy detector is 133 eV/10 mm2, which makes it possible to analyze elements from beryllium to plutonium. Scanning electron microscope analyzes were performed under high vacuum conditions. The microanalysis of the chemical elements of the sorbents was carried out on the same device, studied in fields with an accelerating voltage of 20 keV and a current of 1 nA. In this work, electron scanner images were obtained at 30 keV, magnified by 1000, 500, and 100 times. For an initial comparison, the data of elemental analysis and scanning electron microscope of raw materials KU-2.8 are shown in Fig. 1.

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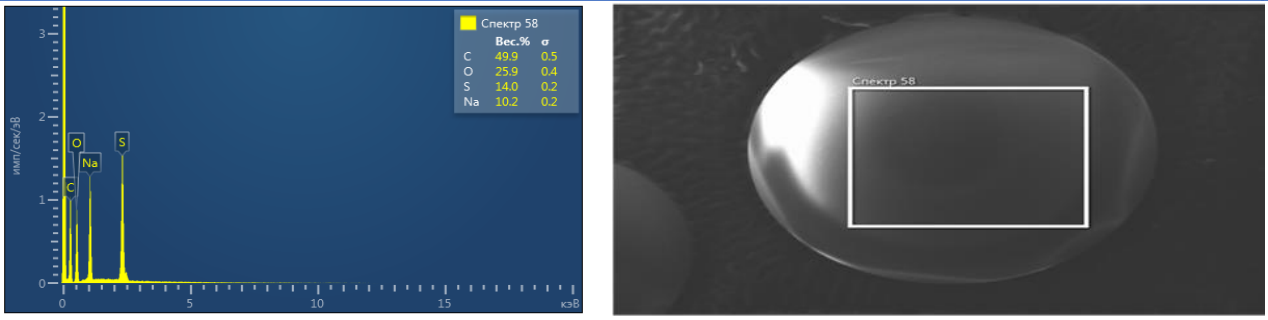

Fig - 1. SEM image and elemental analysis of the KU-2.8 cation exchanger

On the SEM image of the KU-2-8 cation exchanger in Figure 1, it was found that the surface of the granules is smooth, the mass fraction of the functional group in the composition of the elements is 39.9%, and the sodium ion is 10.2%. Further, our method of physicochemical analysis, SEM image and elemental analysis of the carbon sorbent GS-1, obtained using a scanning electron microscope, were studied. The SEM image and composition of the elements of the carbon sorbent GS-1 are shown in Figs. 2.

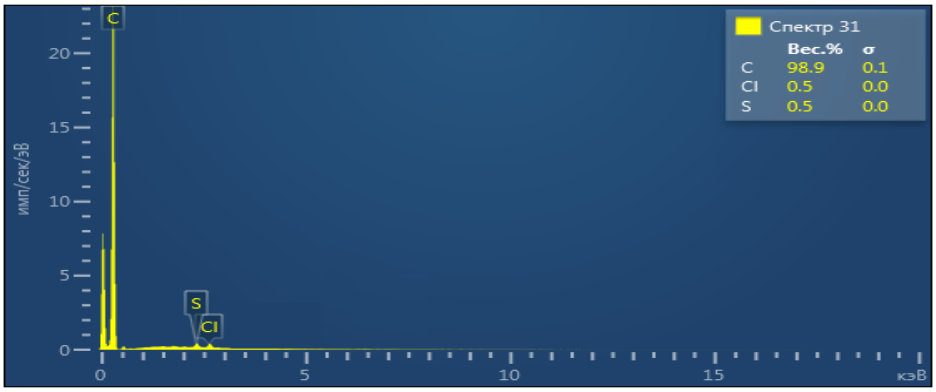

Fig - 2. Elemental analysis of the sorbent GS-1

From the elemental analysis of the obtained sorbent, it can be seen that the percentage of carbon was 98.9%.

The remaining elements appearing in the analysis of the elements are volatile substances that do not impart toxicity to the sorbent when applied to biological fluids.

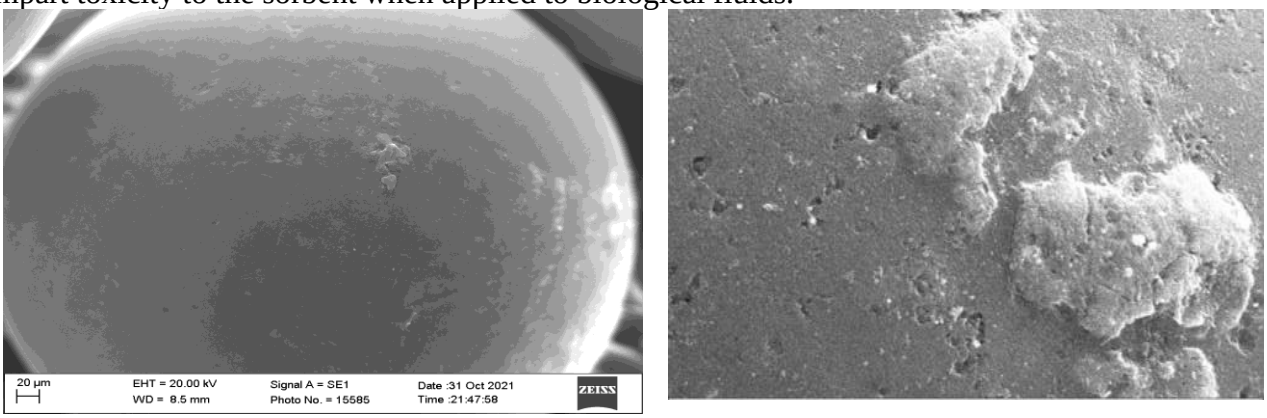

Fig - 3. Scanning electron microscope data (magnification 20, 1000x) of the GS-1 sorbent.

The surface structure of the GS-1 sorbent was studied using a scanning electron microscope (SEM). The study of the surface morphology of the GS-1 sorbent obtained by SEM is one of the important

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indicators, the surface uniformity is the formation of pores, and at the same time it will be possible to observe and study the composition and structures at different technological stages. It can be seen that the surface of the sorbent is smooth, and its pores are clearly visible at a magnification of 1000 times. The curve of thermogravimetric analysis of the coal sorbent obtained on GS-1 was studied, and the results of the analysis are presented. The result of thermal analysis of the obtained sample of the carbon sorbent GS-1 is shown in fig. 4, which consists of two curves. Analysis of the thermogravimetric analysis (TGA) curve (curve 1) shows that the mass loss on the TGA curve mainly occurs in the 2nd temperature range.

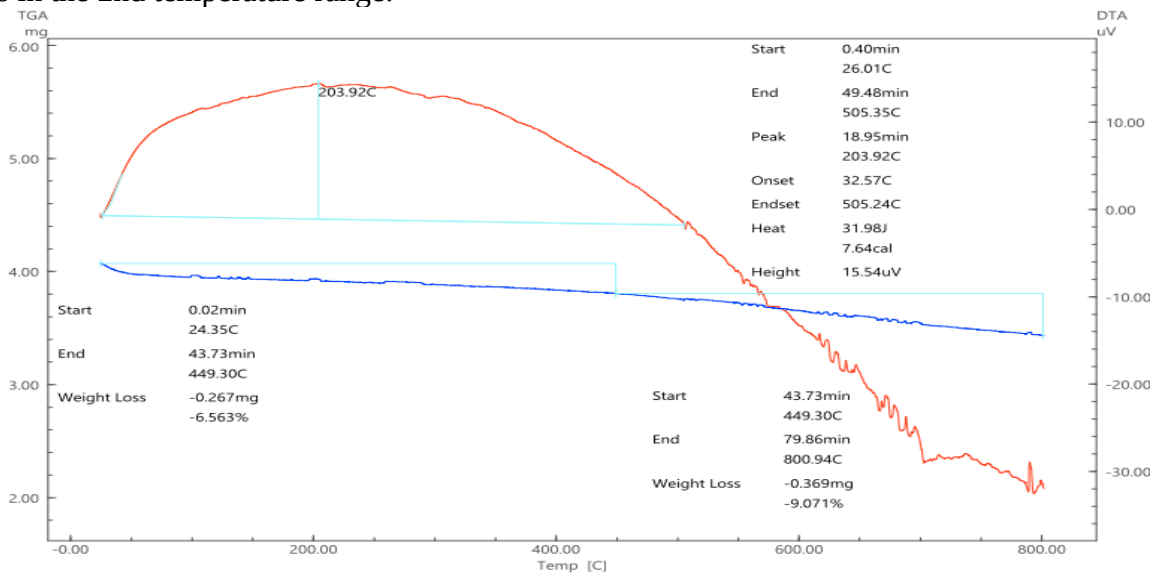

Fig - 4. Derivatogram of the coal sorbent GS-1

The 1st disintegrating interval was realized at a temperature of 24.35 ºC - 449.30 ºC, and the 2nd disintegrating interval was realized from 449.30 ºC to 800.94 ºC. A detailed analysis of the thermo gravimetric analysis curve and the dynamic thermo gravimetric analysis curve is presented in Table 1.

Table 1

Analysis of the results of TGA and DTA curves of the obtained coal sorbent grade GS-1

№	Temperature, °C	Lost weight, mg (4.068)	Lost mass, %
1	50	0.090673	2.228
2	100	0.104623	2.571
3	150	0.137073	3.369
3	200	0.136222	3.3486
4	250	0.169473	4.166
5	300	0.187423	4.6
6	350	0.206071	5.06
7	400	0.234021	5.75
8	450	0.265672	6.5
9	500	0.312623	7.68
10	550	0.348272	8.56
11	600	0.416322	10.23
12	650	0.463172	11.38
13	700	0.532022	13.07
14	750	0.568092	13.96

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15	800	0.634422	15.54

The conducted studies show that at 449.30 **°C** the weight loss is 0.267 mg, and at a temperature of 800.94 **°C** the weight loss is 0.369 mg. It can be seen from the figure that the difference between the first and second mass loss is small. The thermo gravimetric analysis curve shows that the absence of additional compounds in the obtained carbon sorbent is explained by a small weight loss. The result of these thermal studies shows that the weight loss was 7.68% at 500°C and 15.59% at 800°C.

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