PHYSICOCHEMICAL ANALYSIS OF ACETYLENE CARBON BLACK

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Abstract*. Improved the quality of black carbon formed as a secondary raw material in the acetylene production process in the methane pyrolysis process. For this, the influence of the concentration of chloride acid, the duration of treatment on the ash content of the black carbon was studied and the process was optimized.*
Keywords*: pyrolysis process, acid, black carbon, acetylene, the degree of sol.*

Introduction. The black carbon is produced on an industrial scale and is also produced in large quantities as a by-product in the high-temperature processing of carbon sources. It is used in the production of rubber, various cables, ebonite, insulating materials [1]. It is also used in adsorption purification of aqueous solutions, in medicine as a drug to prevent poisoning and as a source of combustion. The composition of the black carbon, especially its properties, varies, and its properties depend on the process of formation of the structure, the raw material, technological processes and temperature [2].

The study aimed to reduce the solubility of the black carbon formed from methane pyrolysis.

There are 20 different brands of the organization in the world, which are classified as follows: by method of production; on the composition of raw materials; on the specific surface; on the structural level. The following brands of the black carbon are used for the production of rubber: DG-100, TM-70, TM-50, TGM-33, TGM-30, TM-15, TeG-10, PM-75 and others. The first letter represents the method of production: D-diffusion flame, T-hydraulic flame, P-furnace, Te-air thermal decomposition without participation. The last letters represent raw materials: G-gas, M-oil, GM-gas and oil mixtures [3].

The acetylene carbon black occupies a special place among other structures. The carbon black has high electrical conductivity and a secondary structure. Its particles are connected to each other by strong branched chains.

Not only is the high electrical conductivity of the carbon black but also its secondary structure is important. In terms of its activity, the acetylene carbon black is close to the P-1250 furnace gas carbon black. Carbon black is produced on an industrial scale and is also produced in large quantities as a by-product in the process of high-temperature processing of carbon sources. Used in the manufacture of rubber, various cables, ebonite, and insulating materials [4]. It is also used in the adsorption treatment of aqueous solutions, in medicine as a drug to prevent poisoning, and as a fuel source. The composition of the carbon black especially its properties varies, and its properties depend on the process of formation of the carbon black, the initial raw material, technological processes and temperature. In addition to carbon, carbon black also contains some other elements, including hydrogen and oxygen, which form a strong bond with the individual atoms of carbon. On average, for every fifteenth atom of carbon, there is one atom of hydrogen. Oxygen is bound to the outer atoms of carbon by strong chemical bonds [5].

Methods. In JSC "Navoiyazot" in the process of obtaining acetylene by pyrolysis methane at 1500^0C a large amount of carbon black (technical carbon) is formed. The secondary product of acetylene extraction from methane pyrolysis is carbon black. It was treated with hydrochloric acid of different concentrations at different time intervals and the solubility of the resulting product was determined. Determination of the composition of samples of raw materials and purified products under acidic conditions was carried out using a scanning electron microscope SEM - EVO MA 10 [6].

Results and Discussion. When acetylene is obtained by pyrolysis of methane in Navoyazot JSC, acetylene carbon black is formed, which does not meet the requirements for its use as a filler in the production of polymer materials, due to the presence of a large number of mineral impurities. As a result of the treatment of this structure with hydrochloric acid, the degree of strength was reduced due to the transfer of mineral impurities contained in it into the solution. To do this, 5 g of carbon black was taken, 60 ml of a concentrated hydrochloric acid solution was added and the mixture was mechanically stirred for 1 hour, then it was sanded and filtered [7].

The composition of acetylene black carbon was analyzed for macro- and micro-elements by optical emission spectrometry.

The secondary product of Navoiazot JSC - for analysis was mineralized in the Easy device (Italy), that is, in an amount of 200 mg to bring it to the state of a transparent solution, weighed on analytical scales of the FA220 4N brand.To do this, 6 ml of distilled nitric acid (HNO_3) and 2 ml of hydrogen peroxide (H_2O_2) were added to the sample (200 mg) in an infrared acid purifier (Distillacid BSB-939-IR) and the mixture was converted into a mineral at 1800^0C for 20 minutes.

Upon completion of the mineralization process, the mixture in a test tube was placed in a separate conical measuring flask and diluted to 25 ml with distilled water (BIOSAN, Latvia).

The solution in the flask was placed in special test tubes in the auto-intake section and put for analysis. The prepared sample was analyzed on an Avio 200 ISP - OES inductively coupled plasma optical emission spectrometer (Perkin Elmer, USA). The accuracy level of the device is 10-9g [8].

The composition of acetylene carbon black was analysed for macro- and microelements by optical emission spectrometry. The results of the analysis are presented in Mn-0.366 mg/l, Cr-0.002 mg/l, As-3.157 mg/l, Mg-13.56 mg/l, Na-17.96 mg/l, Li-0.031 mg/l, K-3.77, Ca-55.31 mg/l, Pb-0.053, Hg-0.115 mg/l, V-0.029 mg/l, Ba-0.201 mg/l, Co-0.265 mg/l, Ni-91.62 mg/l, Cu-2.67 mg/l, Zn-0.145 mg/l, Al-22.94 mg/l, B-0.392 mg/l, P-10.43 mg/l, S-0.074 mg/l, Mo-0.071 mg/l, Ag-0.006 mg/l, Sn-0.014 mg/l, Fe-102.3 mg/l,

In the composition of the solution formed as a result of hydrochloric acid treatment, macro- and microelements were also determined by optical emission spectrometric method.

The results of the analysis are presented in Mn-0.182 mg/l, Co-1.017 mg/l, Cr-0.013 mg/l, Ni-0.016 mg/l, Mg-2.062 mg/l, Cu-0.009 mg/l, Na-3.07 mg/l, Zn-0.528 mg/l, Li-0.008 mg/l, Al-4.663 mg/l, K-1.628 mg/l, B-0.047 mg/l, Ca-39.67 mg/l, P-0.793 mg/l, Pb-0.0004 mg/l, Cd-0.026 mg/l, Hg-0.011 mg/l, S-0.416 mg/l, V-0.023 mg/l, Fe-14.26 mg/l, Ba-0.051 mg/l.

Analysis of the results showed the presence of metal salts, soluble and insoluble in hydrochloric acid. The sol level of carbon black was determined relative to ASTM D 1506 and its value was 15.8%. The effect of acid concentration on acid black treatment on carbon black quality was determined. The results obtained are presented in Table 1.

The process took 1 hour. The analysis of the results shows that the sol of the treated carbon black decreases from 15.8 to 0.5% as the hydrochloric acid concentration increases in the range of 1-30%. Increasing the acid concentration by 34% (concentrated) has virtually no effect on the sol of level.

Hence, the optimum concentration of hydrochloric acid in the acid treatment of carbon black is 30%. Under these conditions, the carbon black of sol of rate reached to be 0.5%. So, the sol level of the studied institution is high and is considered unsuitable for use as an additive in the rubber industry. To improve its quality, acid processing is required.

Morphological examination of the surface of carbon black samples was performed using a scanning electron microscope. In general, a sharp decrease in the level of sol of was observed in acidic treatment when 15% acid was used for 1 hour [9-10].

Table 1. Hydrochloric acid to the degree of sol of the carbon black effect of concentration

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Element	Weight. %	Sigma Weight.%
C	96.63	0.21
O	2.77	0.20
S	0.08	0.03
Cl	0.52	0.04
Total:	100.00	

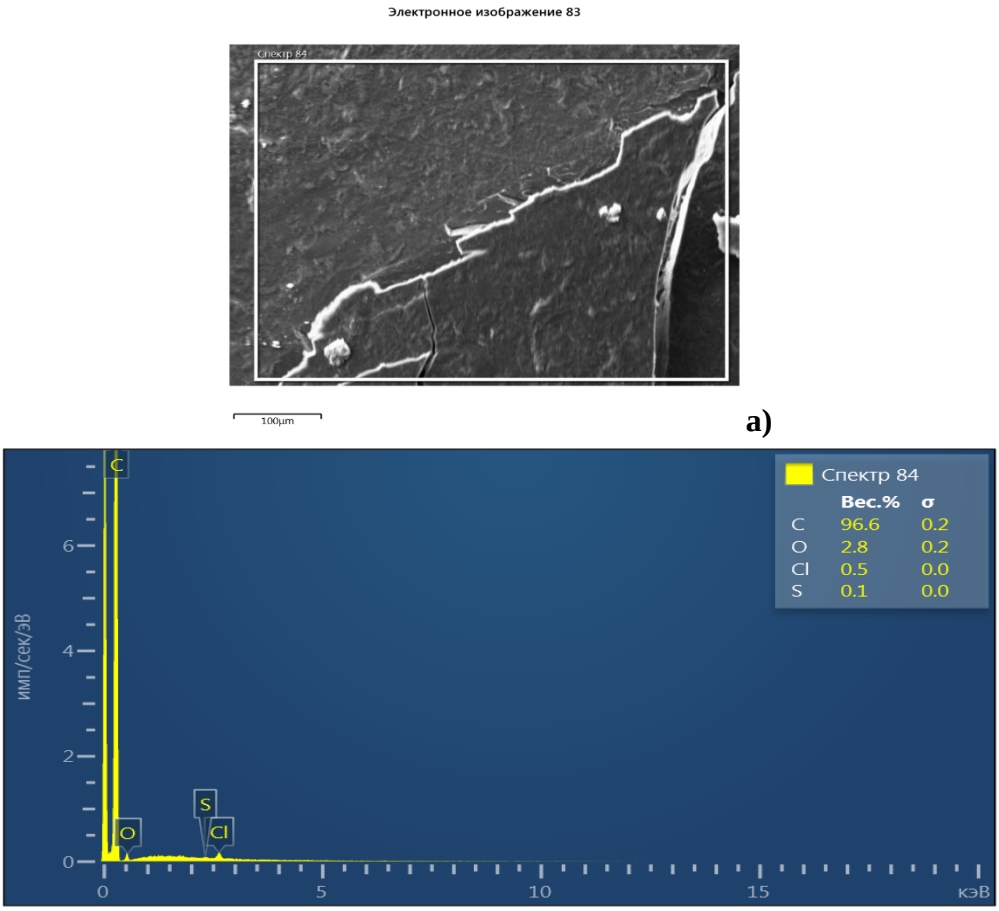

Figure 1. SEM image and analysis of carbon black sample: a) Image of carbon black processed in 15% acid; b) The elemental composition of the carbon black treated with 15% acid

Element	Weight. %	Sigma Weight.%
C	96.16	0.24
O	3.22	0.23
S	0.12	0.03
Cl	0.50	0.04
Total:	100.00	

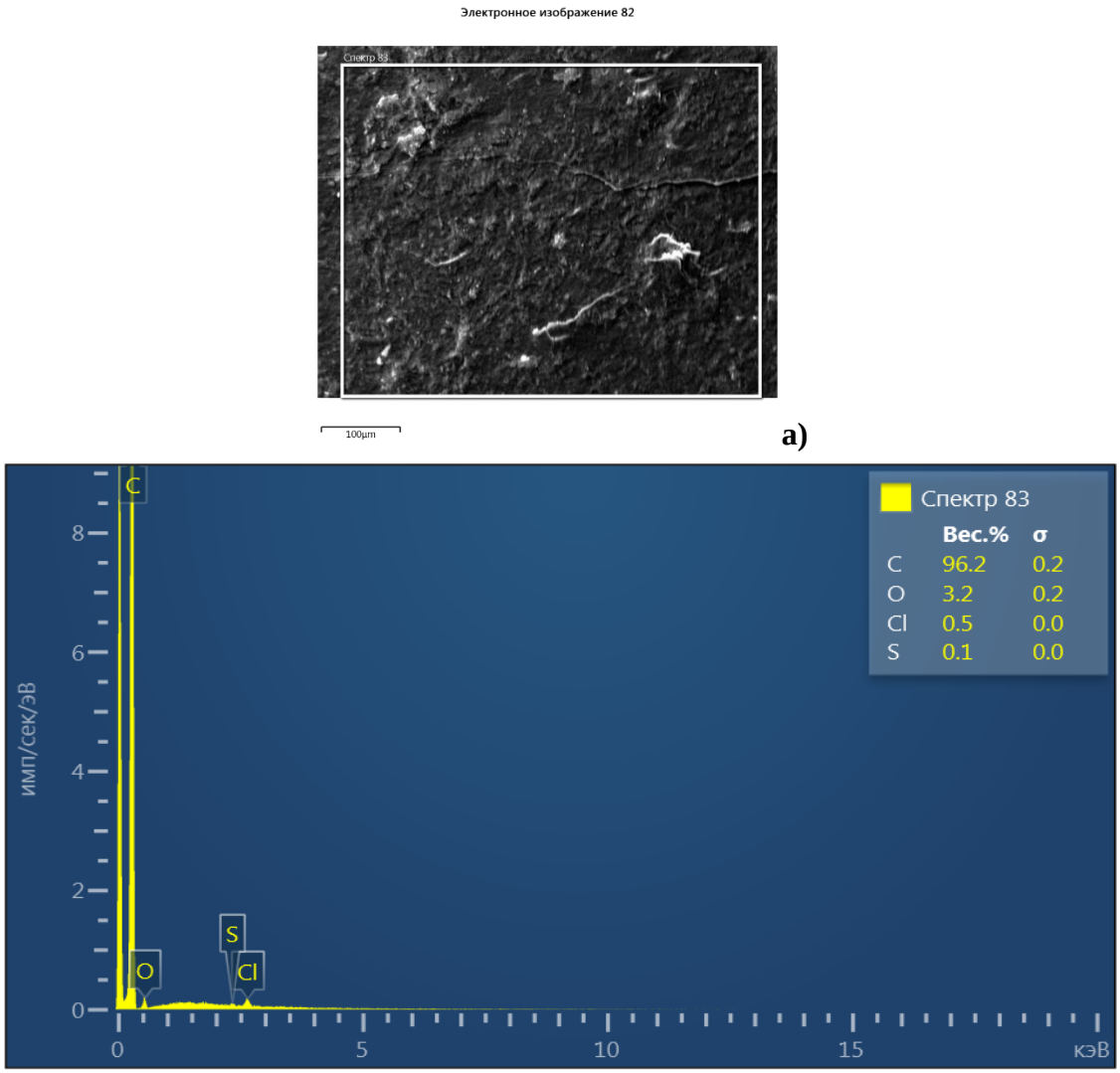

Figure 2. SEM image and analysis of carbon black sample: a) Image of carbon black processed in 20% acid; b) The elemental composition of the carbon black treated with 20% acid

Analysis of the results shows that when a carbon black sample treated with 15% hydrochloric acid is examined under a scanning electron microscope, it has a porous structure. SEM analysis showed that the composition of carbon black is 96.6% carbon, 2.8% oxygen, 0.5% chlorine, and 0.1% sulphur (Fig.1.b). A sharp decrease in the level of sol was observed in acidic treatment when 20 % acid was used for 1 hour [12-14]. A carbon black sample treated with 20% hydrochloric acid has a higher degree of porosity than a sample treated with 15% hydrochloric acid. SEM analysis showed that the composition of carbon black is 96.9% carbon, 2.7% oxygen, 0.4% chlorine (Fig.2.b) [11].

Conclusions. As a result of acid treatment of carbon black, its quality has improved, and the level of sol has been reduced. The effect of hydrochloric acid concentration on the sol of level was determined and the process conditions were optimized. When treated in a 30% solution of hydrochloric acid for 4-5 hours, the sol of the carbon black was reduced from 15.8% to 1.88%.

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