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INVESTIGATION OF THE QUALITATIVE, PHYSICOCHEMICAL AND MINERALOGICAL PROPERTIES OF THE RAW MATERIAL INDEX OF MINERAL LINING BRICKS.

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Abstract

The article provides data on the initial stages of studying the processes of a new direction of mineral processing, in particular, improving the quality of basalt rock by washing them from slimes, cemented salts and hydroxides, as well as processing basalts by dry method in laboratory conditions.

The research was carried out by specialists and scientists of the Metallurgy Department of the Navoi State Mining Institute. The purpose of these studies is to determine the main regularities and optimal parameters of the processes of dry processing of basalt rocks for the production of products for various purposes, to develop technologies for melting basalts and homogenization of the crushed mass, to improve the design of metal melting ovens.

The research results are of theoretical interest and are of a purely practical nature.

On their basis, it is planned to develop designs for metal melting furnaces for light medals with reduced consumption of energy carriers (gas and electricity) and technological costs.

***Key words**: basalt, resource, material, rocks, mineralogical composition, degree of hardness, chemical properties, layering, raw materials, mineral, construction, design feature, liquid basalt, quality, research, melting, furnace, casting, mold, flask, laboratory installation.*

1.1 Introduce the Problem

Heat-resistant lining products make up a significant part of ceramic products for various purposes manufactured in Uzbekistan. This fact can be argued by the widely used in the domestic industry, in particular, the metallurgical industry of various linings and elements used for metal melting furnaces.

In this regard, in order to meet the needs of industry, in particular the metallurgical and chemical industries, large-scale research work is being carried out for lining heat-insulating bricks (FTK). The main requirement for FTC in this case is their refractoriness - the ability to withstand the temperature of the molten metal. A feature of the use of refractory products in metallurgy is the presence of various types of lining. Typically, refractory products are used with few thermal cycles. With the development of high-tech industries, an increase in the number of private, low-power enterprises dealing with the management of "light metals", the demand for ceramic lining heat-resistant functional products with an increased level of physical, mechanical, technological and operational properties has increased more and more.

However, it should be taken into account that the process of their production requires special refractory equipment at FTK operations and chemical requirements, taking into account the specific features of operating conditions. Of all the variety of types of ceramics, the largest share in its production falls on the manufacture of products from ceramic materials, which corresponds to the mixtures of mineral components proposed in this article.

1.1 Introduce the Problem

It has been experimentally revealed that the combination of the constituent materials basalt + kaolin + chamotte provides low firing temperatures for FTC based on basalts, the firing temperature proceeds at temperatures from 1000 to 1400 ° C. This is evidenced by the studied and analyzed indicators of the physicochemical properties of basalts, kaolin and chamotte.

Based on the analysis of the production features and the requirements for heat-resistant types of ceramic materials obtained on the basis of minerals, in particular - basalts, kaolin and chamotte, it has its own specific features and technical requirements.

Requirements for the manufacture of ceramic-lining thermal insulation products can be formulated as requirements for the refractory equipment necessary to obtain quality products. [1-4]. According to the "two-stage" theory of destruction of mineral rocks, the required value of heat resistance can be achieved in two ways: by increasing the resistance of the raw material to external influences or by slowing down the effects of their propagation.

In recent years, there has been a lot of writing about the environmental friendliness of raw materials and quality assurance of finished products. Therefore, we consider it appropriate to note that achieving the quality of manufactured products and meeting consumer demand, in addition to ensuring the specified standard requirements for products, it is also necessary to ensure the quality of the most used raw materials. In our case, the quality of raw materials of basalt rock from the Aydarkul deposit, kaolin and chamotte from the Karnab deposit is considered.

Chamotte is obtained from a kaolin mineral by firing at a temperature of 1600 ÷ 1700 ° C. At this temperature, all the impurities of the processed kaolin are burned out. Then kaolin is passed through a sieve, unnecessary incidental additives are removed. Basalt rocks are mined by open cut from the Aydarkul deposit. The analysis showed that in our case the most polluted mineral was basalt minerals, which cannot be cleaned from impurities without the intervention of special technical means.

Basalts of Uzbekistan are products of volcanic eruptions in the Asian Ocean Field, which existed more than 500 million years ago. These basalts have been in open space for centuries, under the influence of natural phenomena, cemented salts, mud, hydroxides, aerosols, etc. have settled on the surface of the rocks. It should be emphasized that natural basalt stone, due to its high porosity, is susceptible to pollution and adverse effects of its environment.

Inside the building, basalt stone is worn out and exposed to household pollution. For this reason, basalt stone needs proper care, and this is the protection and cleaning of the stone. [5-14]. Since the impurities on the surface of the rock can freely mix with the main part of the raw material and thereby affect the decrease in the quality of the product. However, the high cost of chemical cleaners in this case is an unattractive way of cleaning basalts from impurities. The reason for this is low productivity and high technological costs, which favors mechanical cleaning. [11,13,15,16,17].

Thus, it has been established that the ecological purity of basalt raw materials can be ensured only if, in the process of processing, the basalt rock is subjected to the simplest and cheapest method of mechanical cleaning. This method allows you to easily remove various hydroxides and salts from the surface of pieces of basalt, thereby playing an important role in preventing spontaneous destruction of finished products and reducing the quality of finished products under the influence of harmful impurities. This method can be carried out by washing crushed basalts using metallurgical equipment "butara", which after disintegration is specialized for screening [2,13,15].

Materials and methods.

In this process, the rock is fed for cleaning from sludge after medium crushing, large sizes 250 ÷ 300 mm into smaller pieces. After the first stage of rock crushing, tightly adhered cemented layers of hydroxides and sludge, and in some cases traces of dirt, may remain on the surface of the basalt rock.

The process proceeds as follows. To begin with, basalt in separate pieces, 250 ÷ 300 mm in size, is fed into crushers, depending on the technical parameters of the equipment. The selection of the crushing plant capacity is based on the production capacity of the enterprise. It was revealed that when using the technology of processing hard (3000 ÷ 5000 kgN / sm3) basalts using jaw crushing, separation of the harder fractions of the rock from the less hard ones is achieved.

At the same time, the standard technical capabilities of the crushing plant remain unchanged [3,14. 18.19]. After separation of the solid part of the rock, it is transferred to the machine - butar. Under the influence of the rotary motion of the drum of the machine, the basalt crumbs are divided into smaller pieces and shaken out. The supply of water at this point in the drum helps to loosen the raw material. The presence of corners and annular thresholds inside the drum enhances shaking of the rock pieces and thereby creates an artificial flushing. The dimensions of the holes in the walls of the drum are adjusted to the size of the crumbs, freed from the impurities of large pieces of basalt rock.

The effectiveness of the recommended cleaning method has been proven by conducting an experimental study to remove cemented layers of hydroxides and sludge from the front surface of basalts. The experiment was carried out on 200 kg of basalt samples from the Aydarkul deposit. After washing, all basalt rock samples were dried. Studies show that after crushing and washing, the mass of rock impurities seen from 200 kg averaged 1.5 kg of the total mass. The experimental results are shown in Fig. one.

Weight loss, kg

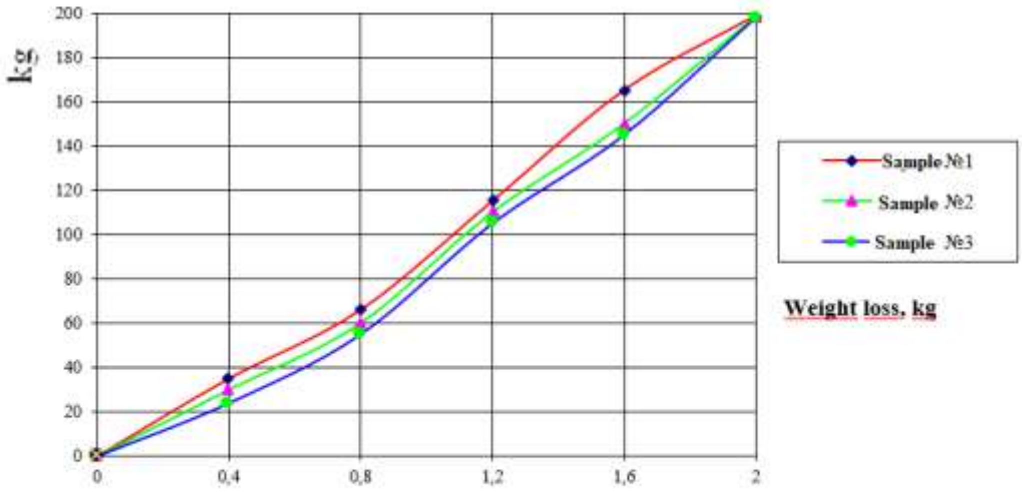

Fig. 1. Dependence of weight loss on the initial during washing

A similar approach to performing operations is easily accomplished with the help of the lattice wall of the butar, which in this case plays the role of a sieve, the size of which is adjusted to the size of the crumbs in a very simple way. In the course of the research, it was revealed that the dependence of the heat-insulating characteristics of materials on temperature and humidity are of very important scientific and practical importance. In this case, one of the most important characteristics of raw materials is low thermal conductivity.

And this, as mentioned above, allows the use of an object with a lower coefficient of heat exchange, which reduces the load on the equipment supplying heat. Since the coefficient of heat exchange - thermal conductivity helps to establish the transferred per unit time through a unit of isothermal surface area with a temperature gradient equal to one. The thermal conductivity coefficient λ is obtained in Vt / (mºK).

The methods and methods of testing the thermal conductivity of materials in different countries differ significantly, therefore, it is imperative to provide data on the test conditions under which the measurements were carried out, for example, on temperature, this will allow a more thorough comparison of the thermal conductivity of various materials.

The value of thermal conductivity of porous materials, including minerals, depends on the type, size and location of pores, material density, molecular structure and chemical composition of solid parts of the base, type and pressure of the gas filling the pores, and the emissivity of the surface bounding the pores. But the most important indicators of mineral materials recommended for the manufacture of basalt lining materials are their heat resistance and humidity.

These factors have the greatest influence on the thermal conductivity coefficient.

Experimental research shows that of these two indicators, humidity has the greatest influence on operating conditions, although with an increase in temperature, the thermal conductivity of materials also increases significantly. The thermal conductivity of thermal insulation and building materials is significant, and also increases with increasing humidity.

Thermal conductivity - the ability of material bodies to conduct energy (heat) from more heated parts of the body to less heated parts of the body through the chaotic movement of body particles (atoms, molecules, electrons, etc.). Such heat exchange can occur in any bodies with heterogeneous ones. For a quantitative assessment of thermal conductivity, there is a coefficient of thermal conductivity of materials. The thermal conductivity coefficient of basic structures should be within the range of 0.03-0.05 Vt / (m°K). [20-23].

Experience shows that the recommended composition of FTC will constantly be under the influence of a heat wave and that it is of no small importance to determine changes in inorganic substances in a mixture of components "basalt + kaolin + chamotte". Therefore, in this case, the method of IR spectrometry was used, which made it possible to clarify the state of the structural features of the listed minerals.

The study of the structural change of basalts in the course of thermal influences was carried out by studying the heat treatment of the rock, which is based on their characteristic indicators. To determine the changes in inorganic substances in basalts and components of the FTC, the method of IR spectrometry was used, which made it possible to find out the state of the structural features of the basalt rock and the constituent materials. Figure 2 shows images of IR spectrometry.

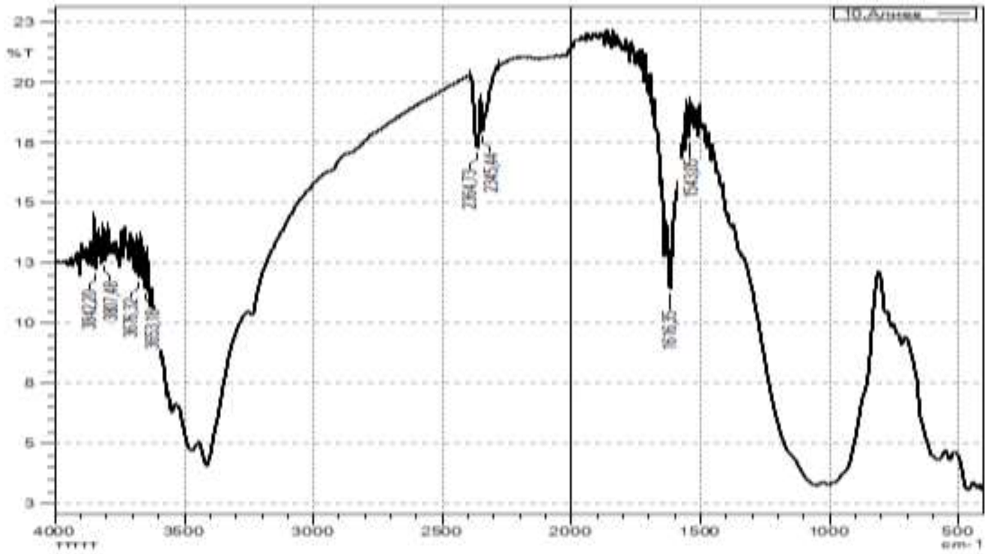

Table 1

The main absorption bands of the IR spectra of basalt

Absorption bands	Wavenumber, sm-1	
	initial	Product after heat treatment
Al – O – Al	437,9	474,1
Al – O – Al	541,7	–
Al – O –Al	582,4	–
Si – O – Si	632,3	–
Si – O – Si	731,1	737,0
Si – O – Si	773,6	–
Si – O – Si	999,7	995,2
Al – O –Al	1102,9	–
Si – O – Si	1452,8	–
Si – O – Si	1642,9	–
Al – O – Al	2643,7	2636,3
Al – O – Al	–	3643,8
Al – O – Al	–	3739,4
Al – O – Al	–	3888,5

The identification of substances by IR spectra is carried out by comparing the full IR spectrum of the analyte with the spectra available in the electronic library, as well as with the spectra of standards. The high resolution of the Nicolet 6700 spectrometer allows you to observe absorption bands caused by a change in the dipole moment of a molecule during rotation or vibration of its constituent atoms, isotopic substitution in a molecule, its symmetry and the number of electrons on the outer shells. The absorption band 737.0 cm-1 refers to the deformation vibrations of the Si-O-Si bond, and 474.1 sm-1 to the vibrations of the silicon-oxygen tetrahedron.

Analysis of the IR spectra of basalts allows us to conclude that aluminum oxide completes the polymer tetrahedral network of the silicon-oxygen polyanion and is presented in the form of [AlO4] 5-. In the material under study, iron oxide, like aluminum, tries to complete the silicon-oxygen framework due to the lack of silicon oxide; in this case, to a greater extent, iron oxide is in the tetrahedral coordination [Fe2 + O4 / 2].

To determine the changes in inorganic substances in kaolins and chamottes, he made it possible to find out the state of the structural features of the listed minerals. In fig. 3. shows the IR spectra of the samples of kaolin and chamotte. The formation of a strong bond between kaolin co-components confirms the flat bond between the rock grains, which were determined by calculation.

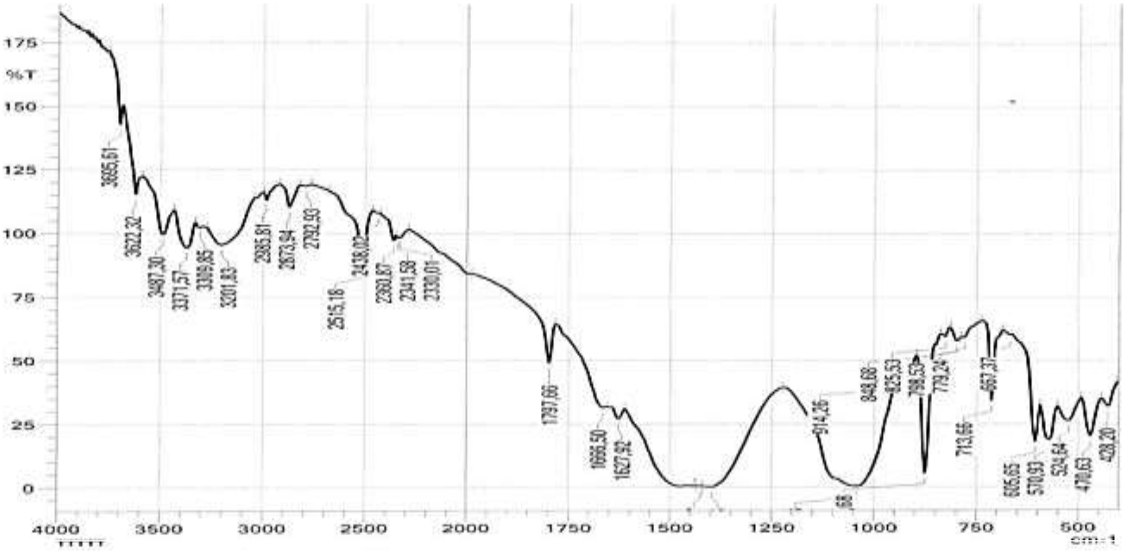

Fig. 3. IR spectra of samples of kaolin minerals and chamotte raw materials: akaolin from the Karnab deposit; b-chamotte obtained from Karnab kaolin.

According to the results of the calculation and taking into account the specific features of the raw material used for the FTM, the indicators: (by options): a) = 3.0 ÷ 3.1gm^3; on option b) = 1.7gm^3; on variant c) = 1.4 ÷ 1.5gm^3 and on variant a) = 1.7 ÷ 1.9gm^3, which gives preference to kaolin "Karnab" than kaolin "Alyans". Obtained from kaolin, by firing "chamotte" showed good results in density (p = 3.5 gm^3), which is higher than the density of basalt rock.

Fig. 4 X-ray diffraction pattern of unfired basalt FTM containing basalt + kaolin + chamotte.

Thus, according to the data of the IR spectrum of the basalts of the Aydarkul deposit, it was established that the composition of this basalt rocks formed a strong bond of silicate compounds.

Annealed FTK acquires the appropriate strength and standard shape that meets all technological requirements of existing standards. The composition of materials obtained on the basis of "basalt-kaolin-chamotte" was subjected to X-ray fluorescence analysis in an EDX-7000 drive (Shumardzi).

The foregoing are confirmed by the results of X-ray studies presented in Fig. 4. and 5 basalt FTK in the composition of basalt + kaolin + chamotte (in the mass ratio: 50 + 20 + 30). The spectra of the chemical composition of composite materials were obtained before firing (at a temperature of 1300 ° C).

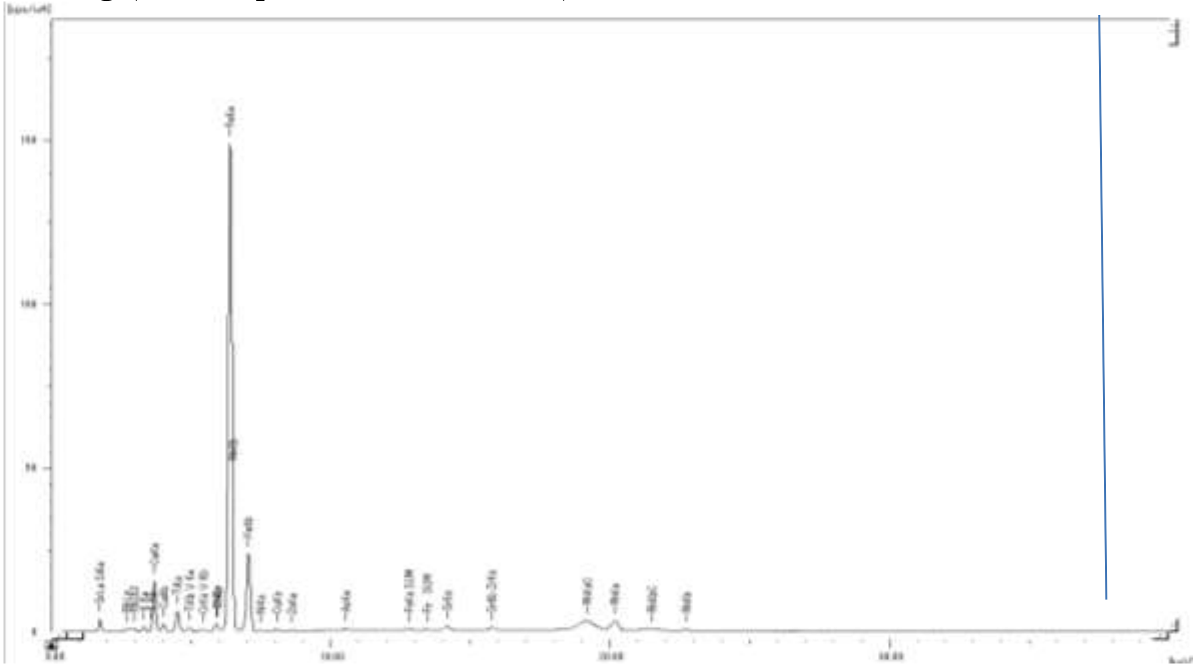

Fig. 5 - X-ray diffraction pattern of fired basalt FTM in the composition of basalt + kaolin + chamotte.

The study of the phase composition of the initial raw material FTC and the products of heat treatment of the charge is carried out using X-ray analysis. X-ray structural studies were carried out on DRON 4-07, which was modified for digital signal processing. The filming was carried out with copper radiation (K) according to the Brega - Bretano scheme with a step of 0.020, an exposure time at a point of 1 sec, in an angular range of 20–92, with a tube voltage of 30 KVt and a beam current of 25 mA. Quantitative phase analysis was carried out using the full profile method [13]..

The diffraction maxima of quartz (d = 0.474; 0.367; 0.182 Nm) are pronounced on the X-ray diffraction pattern of the basalt rock. Along with them, studies revealed the presence of aluminosilicate compounds (d = 0.323; 0.296 Nm) and pyroxenes (d = 0.253; 0.2015 Nm).

Basalts are characterized by ionic and covalent bond types. Si - O and Al - O form a rigid directed covalent bond in basalt minerals. The unification of silicon-oxygen tetrahedra occurs by generalizing only the vertices of the tetrahedra, and not the edges or faces. X-ray analysis carried out on a Bruker AXS D8 Advance diffractometer showed that the crystalline phases of the materials are represented by calcite, anorthite, augite, chlorite, small amounts of magnetite and albite.

The results of X-ray study of basalts showed that the mineralogical composition of the crystalline phase is represented (in wt.%) By calcite minerals $CaCO_3$ - 29.8; albite NaAlSi3O8 - 27.7; silicon SiO_2 - 35.9; alkaline basalt (Mg, Fe, Al, Ti) (Ca, Na, Mg, Fe) (Si, Al) 2O6 - 6.6. The total content of amorphous phases of thermally treated basalts at 1000ºC is determined from the intensity of the nonlinear background. Heat treatment of basalts at 1000 °C is explained with the beginning of the softening temperature of the rock.

During heat treatment, a background on the X-ray diffraction pattern and an expansion of the peaks are formed; anorthite phase is formed (47.6%), in addition, the crystalline phase is represented by calcium oxide (19.5%) and alkaline basalt (21.2%), high-temperature quartz (11.7%). As can be seen from the results, it is impossible to obtain anorthite phase based on pure basalt. The results of X-ray diffraction analysis helped to reveal that during heat treatment of the basalt composite, a silicate compound of the rock is formed: pyroxene, olivine and plagioclase and kaolin and chamotte minerals, which significantly affect the phase changes of the mineral raw material.

Figure 5 shows the results of the chemical analysis of the FTC components fired in the temperature range 900-1300 °C.

The data presented in Table 2 shows their superiority in comparison with the thermal stability of the existing lining materials used in low-power metal-melting furnaces.

In this regard, the study and determination of the structural change in basalts is of particular interest in connection with the peculiarity of mineral compounds. Therefore, deviating from traditional composite lining materials, we study the consequences of thermal treatment of mineral rocks. In contrast to traditional lining materials, they have low thermal stability, consist exclusively of mineral compounds, rely on inherent indicators and are used in the proposed composition for the first time.

Tab. 2.

Results of chemical analysis of FTM components fired in the temperature range 900 ÷ 1300ºC

Name of samples FTM	Firing temperature, ºC	The content of oxides on the constituent chemical elements in wt.%										п.п.п	Σ	MgO/SiO_2
		SiO_2	Fe_2O_3	FeO	MnO_2	Al_2O_3	CaO	MgO	K_2O	Na_2O	TiO_2			
Components of the mixture: "Basalt + kaolin + chamotte"	900	43,7	2,20	4,50	0,09	9,11	4,92	2,79	0,16	2,16	1,5	29,78	99,78	0,063
	1000	45,11	2,72	4,80	0,013	9,45	5,54	2,97	0,17	2,46	1,5	24,70	99,70	0,065
	1100	49,90	2,92	5,66	0,03	9,87	6,46	3,48	0,18	2,82	2,1	19,02	99,02	0,069
	1300	55,62	3,31	6,22	0,11	10,2	8,72	3,38	0,19	3,22	2,3	6,06	99,06	0,0,60

It was revealed that the chemical composition of the basalt rocks of the "Aydarkul" deposits has distinctive features in comparison with the data of the "Asmansay" deposit. For example, in the composition of the basalts of the Aydarkul deposit, the content of silicon oxide reaches up to 63%, and in the Asmansay basalts up to 53%, iron oxide up to 9%, and in the Asmansay basalts up to 15 and 20%, in the Aydarkul basalts such chemical elements as Ib, Li, I have not been found, and, on the contrary, Yb and J contents have not been found in the basalt of the Asmansay deposit, and so on. In general, the analysis showed that the processing of "Aydarkul" basalts by melting is a labor-intensive and energy-intensive process with high technological costs.

The composition of the basalts of the Aydarkul deposit contains olivine in the range of 13.7 ÷ 18.7%, pyroxene in the range of 19.3 ÷ 23% and plagioclase - 34.6 ÷ 54%. The mineralogical composition of the basalts of the Asmansay deposit contains: olivine in the range of 11.7 ÷ 23.7%, pyroxene in the range of 17.3 ÷ 21% and plagioclase in the range of 31.6 ÷ 50.1%. In the studied samples of basalt rock from the Aydarkul deposit, no such chemical elements as Zn, Cd, Ag, Bi, Ge, Ti, Sb, W, Sn, In, As, and P were found. Asmansay ”the listed elements are present in a noticeable amount. [15].

It was revealed that the oxidation of the composition of basaltic rocks is due to the forces of bonding between oxygen and chemical elements of metals, which form a rigid crystal lattice.

The bonds between oxygen and elements such as Al, Fe, Mg, K, N, Ti and Si stand out in particular. [5].

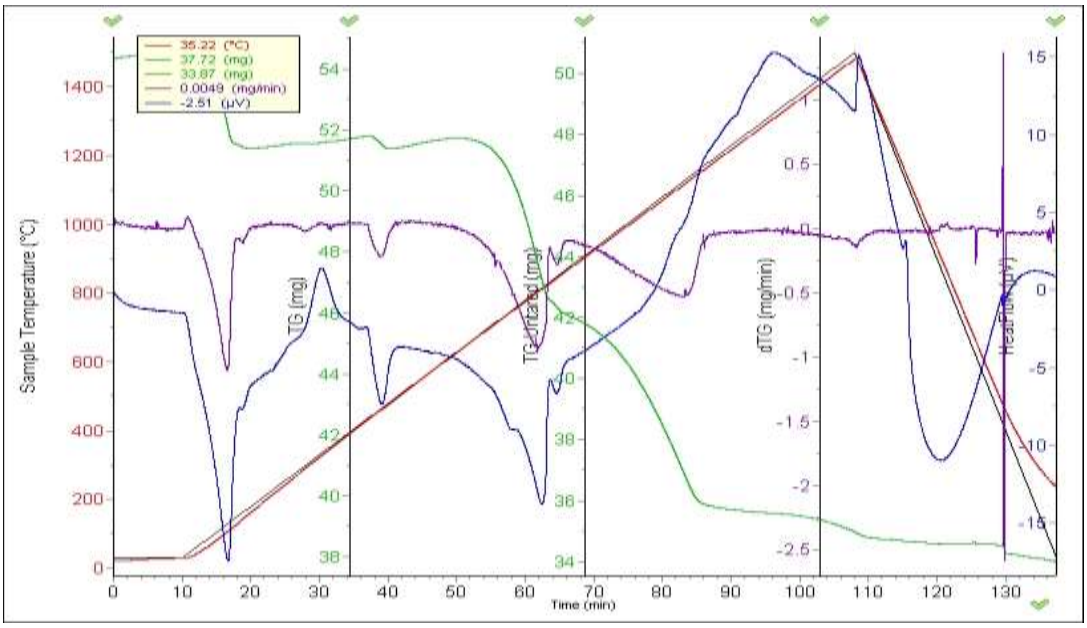

Fig. 6. Derivatogram of the results of heat treatment of the Aydarkul basalt samples.

Comparative analysis of the physical and chemical characteristics of the selected minerals showed that 24 chemical elements were found in the Aydarkul basalts, of which magnesium and sodium, silicon, iron, aluminum, calcium are rock-forming, the rest of the chemical elements in the rock are insignificant. The final result of chemical analysis was obtained after conducting an experimental study to study the results of semi-quantitative spectral analysis of basalt rock.

Investigation of the process of thermal impact on basalts, where the transformation of basalt rock occurs, the derivatograms shown in Figure 6 were taken. In this study, the Labsys EVO Setaram device was used. Where the heating temperature reaches from 50^0C to 1200^0C. In this case, the heating rate is 5^0C/min. На основании полученных результатов исследования по дериватограммы, образцы подвергали термической обработке при температурах: 100, 300, 500,700, 900, 100 и 1200^0C.

A muffle furnace was used for heat treatment. The manifestation of the endothermic effect of the thermolysis process, which appears at a temperature of 80 ÷ 2400C, has been studied. They show the decomposition of clay impurities or the removal of hygroscopic water contained in rocks.

Subsequently, at a temperature of 5200C, weakening of the effects and an increase in mass by an insignificant value are observed, which corresponds to the interconversion of the constituent part of the basalts. Investigation of the process of thermal impact on basalts, where basalt rock transformations take place, are expressed through derivatograms.

In this study, a Labybsys IVO device was used, where the heating temperature reaches from 50°C to 1200°C. In this case, the heating rate is 5 ° C / min. Differential scanning calorimetry (DSC) (4), dynamic thermogravimetric curves (DTGA) (2) and TGP curves (3) of carbon-containing material.

Analysis of the DTGA curve shows that the curve consists mainly of two sigmoids, which occur in two stages.The first stage occurs in the temperature range from 150 ° C to 700 ° C, while the weight loss is 11.46%, the second stage occurs in the temperature range from 750 ° C to 1200 ° C, while the weight loss is 23.7%. When heated to 600 ÷ 900 ° C in an oxidizing environment, iron monoxide contained in olivine is oxidized to iron oxide, and olivine transforms into forsterite ($2MgOSiO_2$) and clinoenstatite (MgOSiO2). At temperatures above 1200°C, iron oxide reacts with forsterite and forms magnesium metasilicate. Magnesium metasilicate has four modifications, so their presence in refractories is impractical.

The study and analysis of the TGP curve shows that the rate of decomposition of carbon-containing material in the temperature range 600-1080 ° C is maximum and is 2.88 mg / min and the amount of consumed energy, respectively, is 8.430 mv*c/mg. Differential scanning calorimetry (DSC) (4), dynamic thermogravimetric curves (DTGA) (2) and TGP curves (3) of carbon-containing material.

With an increase in temperature, the process of crystallization of amorphous products of the starting raw materials occurs. At the same time, as a result of the destruction of the crystal structure of natural basalt, due to the heat treatment process, it causes the manifestation of the second exothermic effect in the temperature range of 820-

840 ° C. This phenomenon can be explained by the discovery of three endothermic effects in raw materials (at temperatures of 120-160 ° C, 335-375 ° C, 580-590 ° C, respectively) and two exothermic (at temperatures of 300-450 ° C and 700-720 ° C) effects.

It has been established that the shape of the thermal curves is associated with the thermal insulation of the raw material and with the characteristics of the basalts of the Aydarkul deposits. [1-80]. It should be noted that the temperature transitions of endothermic and endothermic effects in composite specimens do not in any way affect the quality of the obtained FTC and naturally depends on the inherent and material indicators of the constituent materials of the FTC. The difference in the temperature transition of FTK also directly depends on the chemical properties of materials and the mineralogical composition of the composite made on the basis of Aydarkul basalts.

Thus, the results of differential thermal analysis of samples of samples, based on the investigated PTK, showed that the manufacture of PTK at a temperature range of 900-1200 ° C is of scientific and practical interest. In such cases, a specific feature of the rock is highlighted, in particular basalts. Especially in this case, basalt can undergo phase changes in the chemical composition, restoration of the structure and properties of the liquid or solid phase of the raw material.

It was revealed that if we take into account that the composition of basalts consists of: olivine - containing (Mg, Fe) 2 SiO_4 and MgO, FeO, Na_2O and CaO radicals, then its melting point reaches 12500C; pyroxene – containing - R2 [Si_2O_6], mainly consists of R – Mg, Fe, Ca, Al and Na radicals, the melting point reaches 1450^0C and plagioclase - Na [$AlSi_2O_3$], mainly consists of SiO_2, Al_2O_3, CaO, Na_2O, with K and F impurities and at that time represent an isomorphic series of albite and anorthite, which have different melting points, sometimes reaching 1550C, then phase changes in basalt are inevitable.

In the temperature range of 1000 ÷ 1200 ° C, the process of new formations of the FTC occurs, as a result of which a dense composition is formed, which contributes to the attainment of the holding temperature from 1250 ° C to 1400 ° C and above. With a further increase in the firing temperature (up to 1450 °C), softening of the composite, changes in shades and FTC melting are observed.

The dehydration process manifests itself in the form of small thermal effects in the region of 150-700 ° C, which do not have obvious extremes and are accompanied by a weight loss of 11.46%. It was noted that the mineral contains water of a zeolite nature and its release upon heating is, as a rule, a continuous process not clearly divided into separate stages, which appear at certain temperatures.

In addition to these effects, when basalt is heated in the temperature range of 600-700 ° C, an endothermic reaction takes place. The presented indicators correspond to the separation of structural water from basalt. And the following exothermic effect in the temperature range within 750 ÷ 1200 ° C (in this case, the weight loss is 23.7%) is associated with the formation of Mg [SiO4], which proceeds according to the reaction:

Olivine $\xrightarrow{400^{\circ}C}$ 700ºC

Pyroxene → $2Mg_3Si_2O_5(OH)_4$ → $3Mg2[SiO_4]+SiO_2+4H_2O$

Plagioclase ↗ Serpentine Forstreet

Forsterite With a significant amount of iron in the basalt fraction, in addition to forsterite, fayalite can also form. Melting of fayalite proceeds according to the reaction:

$$Fe_2[SiO_4] \rightarrow 2FeO+SiO_2,$$

at a temperature of 1200 ÷ 1210 ° C. The results of the analysis show that the rate of decomposition of carbon-containing material in the temperature range 600-1080 °C is maximum and is 2.88 mg / min and the amount of consumed energy, respectively, is 8,430 mv · c / mg, which leads to 3Al2O3 · 2SiO2-mullite formation. Obviously, this result creates a condition for increasing the refractoriness of the lining material.

The phase composition of a well-fired FTK composite is mainly based on the ratio of crystalline phases of silicate compounds: pyroxene, olivine, plagioclase, and chamotte. These silicate compounds undergo a structural change and as a result, interconversion products are created.

Conclusion

The results of differential thermal analyzes of prototypes based on basalts from the Aydarkul deposit showed that in the process of heating the raw materials of the FTC 500 ° C, its dehydration begins, ending at 900 ° C and accompanied by the oxidation of ferrous oxide to ferric oxides. As can be seen from the results of the study, the curves of differential thermal analysis are typical for ordinary mineral natural silicate compounds of rocks. As the temperature rises, softening of materials occurs, which consist of a combination of "basalt + kaolin + chamotte", ie, FTK

In general, the comprehensive (according to GOST ISO 5725-1) studies of basalts made it possible to assess the features of material and chemical compositions and establish numerous endo- and exo-effects during heating and cooling. Comparison of basalt rocks with coexisting normal basalts of Uzbekistan, as well as basalts of other regions, showed that there is a significant difference in chemical and mineral composition and among indicators of technological properties.

Thus, according to the totality of the estimated and specified parameters obtained in the process of theoretical, experimental and precision studies, it can be established that the basalts of the Aydarkul deposit have a low suitability for using them as raw materials for the production of basalt fiber. They can be recommended for organizing the production of non-fibrous basalt products, where basalt rocks are subjected to "dry processing".

A joint general analysis of the chemical composition of basalts by scientists from the Navoi State Mining Institute and the Central Scientific Research Laboratory of the State Enterprise NMMC showed that the content of SiO2 in the composition of the basalt rock of the Aydarkul deposit is in the range of 43.7 ÷ 59.9%.

According to the method of S.D. Belinkin, an increase in the SiO2 content in basalt contributes to an increase in the melting temperature of the rock. Therefore, for the production of fibrous products, basalts with such a high SiO2 content are considered unsuitable and it is advisable to use Aydarkul basalts to process by the “dry processing” method, i.e. without the use of smelting operations. These statements are confirmed by the research results presented in tables: 6 -7.

As a result of physicochemical studies of TM samples based on basalt silicate compounds, it was found that these basalts can be suitable for the manufacture of acid-resistant tiles, refractory materials, Portland cement, as well as for the manufacture of composite materials and insulation. By crushing basalt and further roasting it, which corresponds to the correct choice of the object of study and basalt raw materials.

Thus, it was experimentally revealed that the material ratio of the constituent silicate compounds in the composition of the basalt rock of the Aydarkul deposit is equal to: olivines within 13.7 ÷ 18.7%, pyroxenes within 19.3 ÷ 23% and plagioclase - 34.6 ÷ 54%. It is inexpedient to subject the silicates to such ratios to melting operations due to the high demand for energy resources. Therefore, a practical option is to process Aydarkul basalts with such a composition without using smelting operations.

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