BASALTS AS AN ALUMINOSILICATE RAW MATERIAL FOR THE PRODUCTION OF PORTLAND CEMENT CLINKER

[1]Prof. Mukhamedbaeva Zamira Abduljaparovna, [2]Dr. Kurbanov Erkin lkhamovich, [3]Alieva Rena A’zer Kizi
Tashkent chemical-technological institute, Uzbekistan[1], Tashkent chemical-technological institute, Uzbekistan[2], Senior teacher, of the Jizzakh Polytechnic Institute, Department of Chemical Technology[3]
mzamira1946@gmail.com[1], erkin.kurbanov1976@gmail.com[2], alievarenazeri@gmail.com[3]

ABSTRACT

In connection with the approval in recent years of the global trend towards quality control of industrial products and energy saving, industrial practice in the construction industry begins to impose increased requirements on technological equipment, the quality of raw materials, semi-finished products and final products. The question of the development of the methodology of energy saving, optimization and intensification of heat-technological processes in the industry of silicate building materials in the context of changes in the traditional raw material base, the use of technogenic raw materials, and the production of special products is raised. The properties of the raw materials used have a significant impact on the efficiency of the production of Portland cement clinker. As a rule, the quality of natural materials, especially the clay component, currently does not fully meet the requirements of the technology; therefore, the search for new types of raw materials with high reactivity is very urgent.

Keywords: Portland cement clinker, components, raw material charge, basalt, clay raw materials.

INTRODUCTION

Environmental Impact Assessment (EIA) - is carried out in order to determine the environmental and other consequences of options for management and economic decisions, develop recommendations for improving the environment, preventing the destruction, degradation, damage and depletion of natural ecological systems of natural resources. EIA is a mandatory and integral part of design and pre-design documentation [1].

In recent years, there has been an increasing interest in the creation of new types of aluminosilicate raw materials capable of replacing (in whole or in part) clay rocks in the composition of the raw mixture for the production of Portland cement clinker [2,3,4]. Basalt rocks can be used as a raw material component of increased reactivity [5,6,7]. When firing basalt-containing clinkers, an increased amount of melt of aluminoferritic composition is formed. Since $CaO \cdot Al_20_3$-Fe_2O_3, formed at 1200°C, hydrates faster than $CaO \cdot Fe_2O_3$ of Portland cement, an increase in the content of the alumoferrite phase in clinkers obtained at lower temperatures than traditional compositions, and the enrichment of this phase with iron [8,9,10] can have a beneficial effect on the properties of belite clinkers. In connection with the above, the use of basalt as an iron-containing and aluminosilicate component in the production of belite cement is expedient. The solution to the possibility of using alkaline basaltoids of volcanic origin as an aluminosilicate component of the raw charge for the production of Portland cement was carried out on the basis of an analysis of the state diagrams of the CaO-SiO_2-Al_2O_3 system and the corresponding construction and calculation methods in the three-component systems CaO-SiO_2-Al_2O_3. At certain ratios of basaltoid and limestone, Portland cement clinker can be obtained. However, basaltic rocks contain about 5-8 masses. % alkali, and there are questions about reducing the alkali content in the synthesized clinker. To solve this problem, the simplest way is to use a fluorite additive.

RESEARCH METHODS

The objective of this study is to assess the possibility of using basalts of mountainous origin from the Karakiya deposit as an aluminosilicate component of the raw material charge for the production of Portland cement. We carried out a complex of studies of basalts of the Karakiya deposit using modern methods of physical and chemical analysis. Examined by a microscopic method on an NSI-810 type microscope with a Motic Live Imaging Module type camera. The identification of the samples was carried out on the basis of diffraction patterns, which were recorded on an XRD-6100 apparatus (Shimadzu, Japan) controlled by a computer. We used CuK α-radiation (β-filter, Ni, 1.54178 current and tube voltage 30 mA, 30 kV) and a constant detector rotation speed of 4 deg / min with a step of 0.02 deg. (ω / 2θ-adhesion), and the scanning angle varied from 4 to 80°.

RESULTS AND DISCUSSION

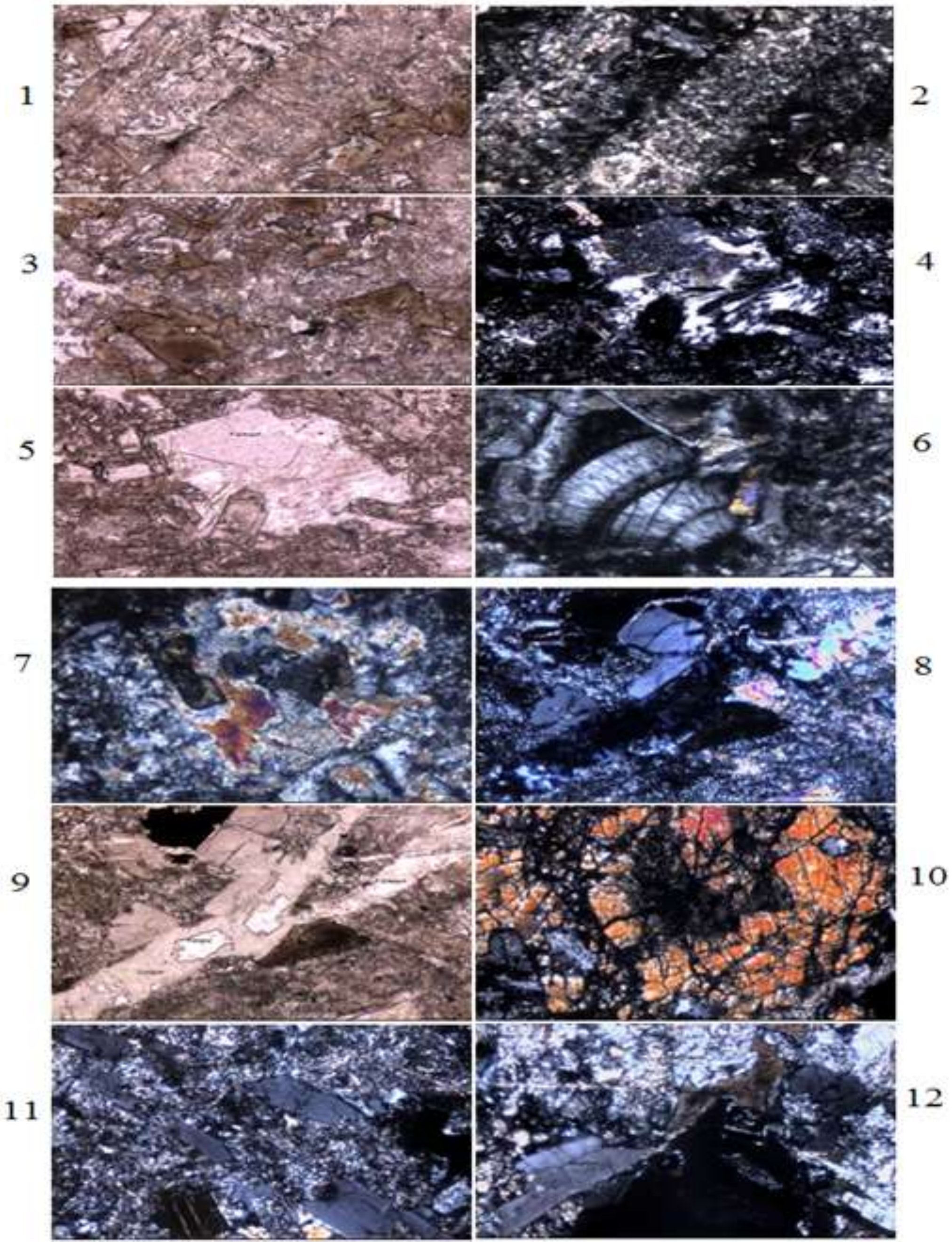
The used basalt deposit is located in the Almalyk region in the southwestern strict Chatkal-Kuramin region. The thickness of the basaltonides is 600-700 m, the length is up to 7.5 km. Eighteen samples were examined.

Table 1. The results of recalculation of the chemical analysis of basalt porphyrite (sample No. 2) for the standard mineral composition (GIPV method).

	Weight, %	*M.K*	*Ilm*	*Ort*	*Alb*	*An*	*Mt*	*Di*	*Hy*	*Q*	*Summary*
SiO_2	42.20	702		54	276	186		44	124	18	
TiO_2	4.83	60	60								
Al_2O_3	15.14	148		9	46	93					
Fe_2O_3	7.42	46					46				
FeO	8.31	115	60				46	7	7		
MnO	0.12	2									
CaO	6.40	114				93		21			
MgO	5.21	129						14	115		
Na_2O	2.84	46			46				2		
K_2O	0.81	9		9							
			8.7%	5.2	26.7	27.0	6.7	6.4	18.0	1.3	100%

The structure of the groundmass is intersertal. Mineralogical composition: sericitized plagioclase-55%; monoclinic pyroxene (chloritized) - 30%; brown hornblende - 3%; ore mineral - 3%; apatite 4%; glass - 2.5%; quartz, chalcedony - 1.5%; titanite 1%; secondary minerals: sericite, calcite, chlorite, chalcedony. The size of large plagioclase phenocrysts is 0.4x 1.8mm, 0.2x1.0mm (Fig. 1,), small prisms - 0.1x0.6mm, 0.2x0.6mm, - modified pyroxene 1.8x3.6mm, 1.4x2.8mm. Pyroxene is represented by poikilo crystals with ingrowths (hadacrysts) of plagioclase prisms (0.04x 0.3mm, 0.1x0.4mm, Fig.1.*10*). Thus, the main background is made up of altered plagioclase prisms, in the interval between its prisms there is brownish cryptogranular glass (nicols are parallel, Fig. 3), chlorite, radial chalcedony aggregates up to 1.4x0.4 mm in size (Fig.1.*4, 6, 15),* calcite (Fig.1. *5,7,14-15*). In addition, irregular grains of gray (nicoli are parallel) mineral (0.2x0.5mm) developed between plagiocase prisms, forming poikilocrysts with ingrowths of earlier minerals, are distinguished (Fig.1. *13*). The mineral has direct extinction, negative elongation, transverse fracturing. Its discharge is often elongated, there are isometric forms (Fig.1. *8-9, 11-13*.). Plagioclase is sericitized with numerous precipitates of sericite, epidote-zoisite (Fig. 1-2), calcite, and quartz. The relics of monoclinic pyroxene are found in large porphyritic segregations of the oikocryst type. Plagioclase inclusions 0.02x0.4mm in size. In the areas of chlorite development after pyroxene, brownish titanite precipitates of irregular shape with a size of 0.03 mm, 0.01x0.1 mm are noted. The calcite is fine-grained, along with chlorite in the veins. In general, the groundmass pyroxenes are completely altered - replaced by a mixture of chlorite and calcite. The rock contains brown hornblende. The pores are filled with calcite, radial-radiant chalcedony, and chlorite. A characteristic feature of the texture pattern is the spotting caused by the development of oikocrystals of pyroxene, ore minerals with TiO_2. Judging by the SiO_2 content, they belong to the main types of basalts. the temperature of the beginning of melting is 1180°C.

Mineralogical composition and structural and textural features of basaltic porphyrite (sample No. 2)



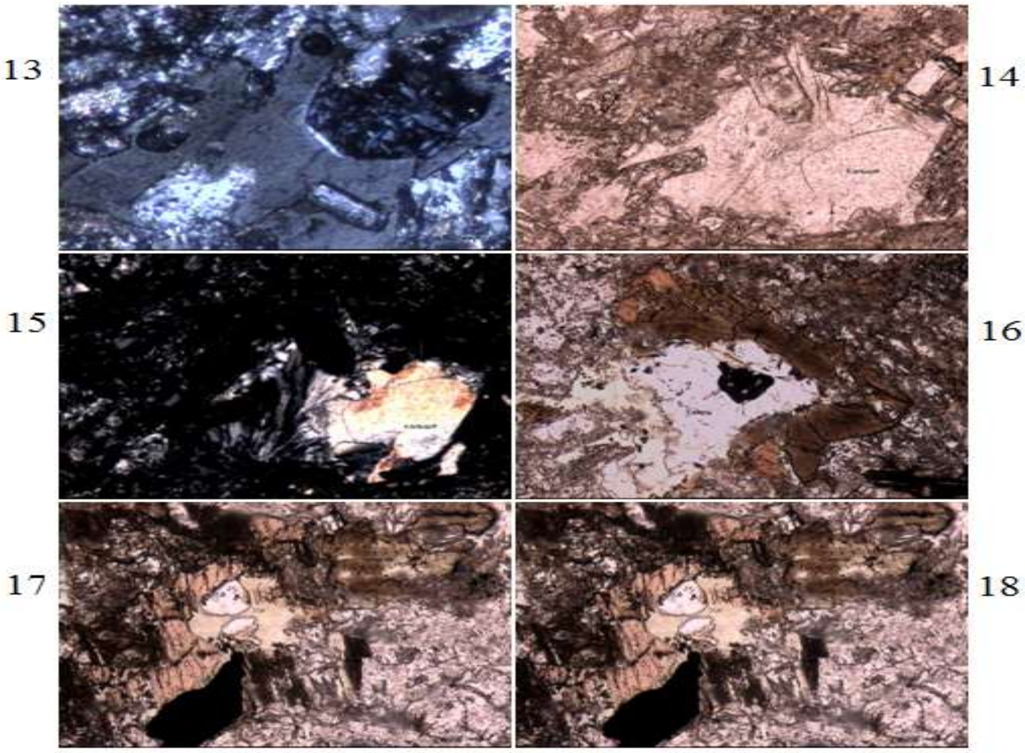
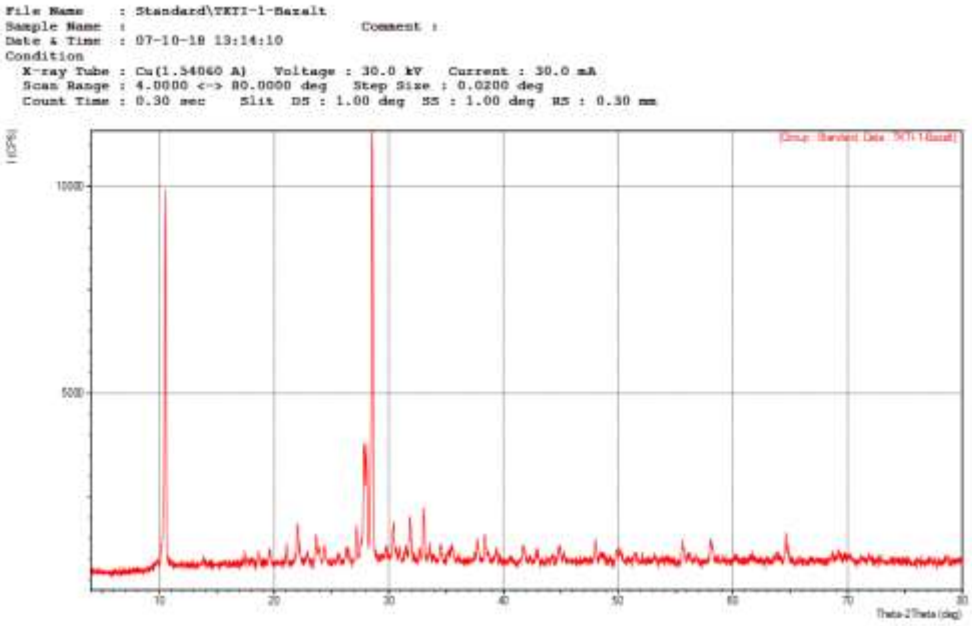


Fig. 1. Captions: x160

1-2 sericitized plagioclase, located against the background of smaller plagioclase crystals and chloritized pyroxene; 3-the gaps between the plagioclase prisms are filled with brownish glass, 4,14,15,6,7-calcite, radially radiant chalcedony, gray mineral with transverse separations (9, 10, 12,13,14); 10-porphyritic poikilocrystal of pyroxene with accretions of modified plagioclase; 16-crystal-grained quartz socket.



```
File Name     : Standard\TKTI-1-Bazalt
Sample Name   :                         Comment :
Date & Time   : 07-10-18 13:14:10
Condition
  X-ray Tube : Cu(1.54060 A)   Voltage : 30.0 kV   Current : 30.0 mA
  Scan Range : 4.0000 <-> 80.0000 deg   Step Size : 0.0200 deg
  Count Time : 0.30 sec     Slit  DS : 1.00 deg  SS : 1.00 deg  RS : 0.30 mm
```

Fig. 2. X-ray diffraction pattern of basalts of the Karakiy deposit

The phase composition of gray dense basalt is represented by: olivine (d / n = 0.245; 0.269 nm), anorthite (d / n = 0.320; 0.269, 0.403, 0.201 nm), augite (d / n = 0.162; 0.255, 0.295 nm), hematite (d / n = 0.260 nm), magnetite (d / n = 0.299 nm), fayalite (d / n = 0.177 nm), viewite (d / n = 0.242 nm), kaolinite (d / n = 0.716; 0.355 nm).

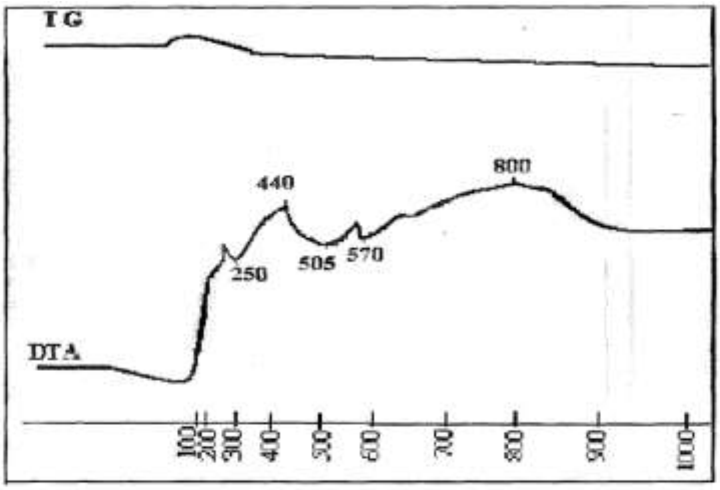


Fig. 3. Diffractogram of porphyritic basalts of the Karakiya deposit

At 800°C, minerals of the amphibole group are already absent. Judging by the decrease and disappearance of many peaks, the process of transition of pyroxene group minerals to the melt begins. At 1200°C, the rock transforms into an amorphous substance. At exposures of 200 and 400°C for 3-4 hours, the diffraction pattern characteristic at room temperature, in general terms, remains. However, according to DTA data, in the region of 80°C (Fig. 5), mechanically bound and adsorption water is removed, as evidenced by the endothermic effect existing in the range of 50-150°C. The endothermic effect at 200-250°C indicates the removal of water between the epidote and actinolite packets. The endothermic effect at 570°C is inherent in the transition of β-quartz to α-quartz. The exothermic peak at 800°C shows a gradual and slow melting of such basalt components as epidote and actinolite. At 1000°C, augite, feldspar and quartz melt in the previously formed liquid phase. Analysis of the composition of the basalt of the Karakiya deposit indicates the multiphase nature of the studied rock. According to microscopic, X-ray and electron microscopic data, they contain several main phases in the form of alkali-containing anorthite with the formula $(Na,Ca)Al_2Si_2O_8$; iron-containing pyroxene solid solution such as diopside $CaMg[Si_2O_6]$, augite $Ca(Mg,Fe^{2+})[Si_2O_6 \cdot CaFe[A1SiO_6]$, aegirir Na, $Fe^{3+}[Si_2O_6]$; actinolite $Ca_2[Mg,Fe]_5[OH]_2[Si_8O_{22}]$; epidote $Ca_4A1_6[OH]_2O_3[Si_2O_7]_3$; quartz SiO_2. Ore minerals are also present in small quantities. A decrease in the temperature of clinker formation is due to the low temperature of the beginning of melting of basaltoid rocks; Portland cement clinker can be synthesized at temperatures of 1250-1300°C, which is 200-250°C lower than when clinker is fired using traditional technology. Considering that the melt appears at 1100°C, it should be expected that only a partial decrease for basalt will occur.

Experimental data in cases of using basaltoids as an aluminosilicate component in a raw mixture were verified both in laboratory conditions and in semi-industrial tests, the results were reported at international conferences and also published in Russian and local scientific journals [14,15,16,17,18]. Physicochemical tests of basalt containing Portland cement have shown that the cements obtained in semi-industrial conditions meet the current Interstate standards; their strength characteristics correspond to Portland cements of the "400" and "500" brands.

CONCLUSIONS

Thus, the entire set of impurity oxides contained in basalts provides an earlier appearance of the liquid phase in basalt-containing raw mixes. The low temperature of the beginning of melting of basaltoid rocks, not only ensures the production of Portland cement clinker, but also due to a decrease in temperature, the appearance of a liquid phase should significantly lower the firing temperature of the clinker, and, consequently, reduce the amount of heat spent on the synthesis of Portland cement clinker.

BIBLIOGRAPHY

[1] Alieva R. A. (2020) Improvement of the ventilation system and dust collectors when collecting fine dust. International Engineering Journal For Research & Development, https ://do i.org /10.17 605/OS F.I O/ 72T5P.

[2] Pashchenko A.A. (1990) Energy-saving and waste-free technologies for producing binders. Kiev: Vyscha School, 223.

[3] Cherkasov, A.V., Pereskok S.A. (2014) The use of fluorspar to increase the productivity of a cement rotary kiln. Cement and its application. 7, 24-25.

[4] Sanjaasuren R., Erdenebat Ts., Rumyantsev P.F. (2007) 12-th ICCC. Montreal, Canada, 3-05.

[5] Sanja Hsuren R., Rymyantsev P.F. (1997) Proc. 10th Inter. Cong. on the Chem. of Cement. - Gothenburg, Sweden, 1, 1037.

[6] Sanjaasuren R. (1992) Proc. 9th Int. Cong. Chem. Cement. New Delhi, 2, 315.

[7] Gurevich B.I., Tyukavkina V.V. (1992) Portland cement clinker based on whitewash slimes. Mining waste as a raw material for the production of building materials. Apatity, 20-27.

[8] Gurevich B.I., Makarov V.N., Tyukavkina V.V., Zinoviev Yu.Z. (1993) Portland cement clinker from carbonatites and belite slimes. Resource-saving technologies of building materials, products and structures. - Belgorod, 12-13.

[9] Klassen V.K., Shubin V.I. (2000) Reports of the II Intern. meetingon the chemistry and technology of cement. - M., 1, 133-145.

[10] Taimasov B.T., Esimov B.O., Terekhovich S.V., Kuralova R.K. (2002) Cements based on man-made waste and igneous rocks.-Shymkent. Publishing house N0RIS, 163.

[11] Gurevich B.I., Tyukavkina V.V. (1993) Influence of Portland cement batch firing conditions on clinker properties. Building materials based on mineral raw materials and industrial waste. Apatity, 11-14.

[12] Makarov V.N., Gurevich B.I., Kremenetskaya I.P., Suvorova O. Tyukavkina V.V. (1999) The use of mining and industrial waste as raw materials for the production of construction and technical materials. Chemistry for sustainable development, 7, 183-187.

[13] Makarov V.N., Gurevich B.I., Tyukavkina V.V. (2000) Carbonate overburden of the Kovdorsky deposit - raw material for the production of Portland cement. Technology and properties of silicate materials of raw materials of the Kola Peninsula. - Apatity, 74-78.

[14] Kurbanov E.I., Mukhamedbaeva Z.A., Mukhamedbaev A.A. (2018) Portland clinker using diabases from the Balpantu deposit. Chemistry chemical technology. 4, 11-14.

[15] Mukhamedbaeva Z.A., Mukhamedbaev A.A., Kurbanov E.I., Adinaev Kh.A. (2020) Synthesis of Portland cement clinker using basalts from the Karakiya deposit Chemical Industry, 5, 225-230.

[16] Mukhamedbaeva Z.A., Mukhamedbaev A.A., Kurbanov E.I., Adinaev Kh.A. (2020) Mineral formation processes of the phase composition of Portland cement during synthesis with natural wollastonite. Chemical industry, 5, 231-237.

[17] Mukhamedbaeva Z.A., Kurbanov E.I., Mukhamedbaev A.A. (2020) Obtaining Portland cement clinker and increasing the efficiency of its grinding. Chemical technology and technology. Materials of reports of the 84th scientific and technical conference dedicated to the 90th anniversary of BSTU and the Day of Belarusian Science (with international participation). Minsk, 94-96.

[18] Olimova N.G., Alieva R.A. (2021) Analysis Of Technological Processes Of The Zarbdor Cotton Cleaning Plant And Dust Collecting Devices. International Journal of Progressive Sciences and Technologies (IJPSAT), Vol. 28 No. 2 September 2021, pp.01-04. Milan, https://ijpsat.ijsht-journals.org/index.php/ijpsat/article/view/3496