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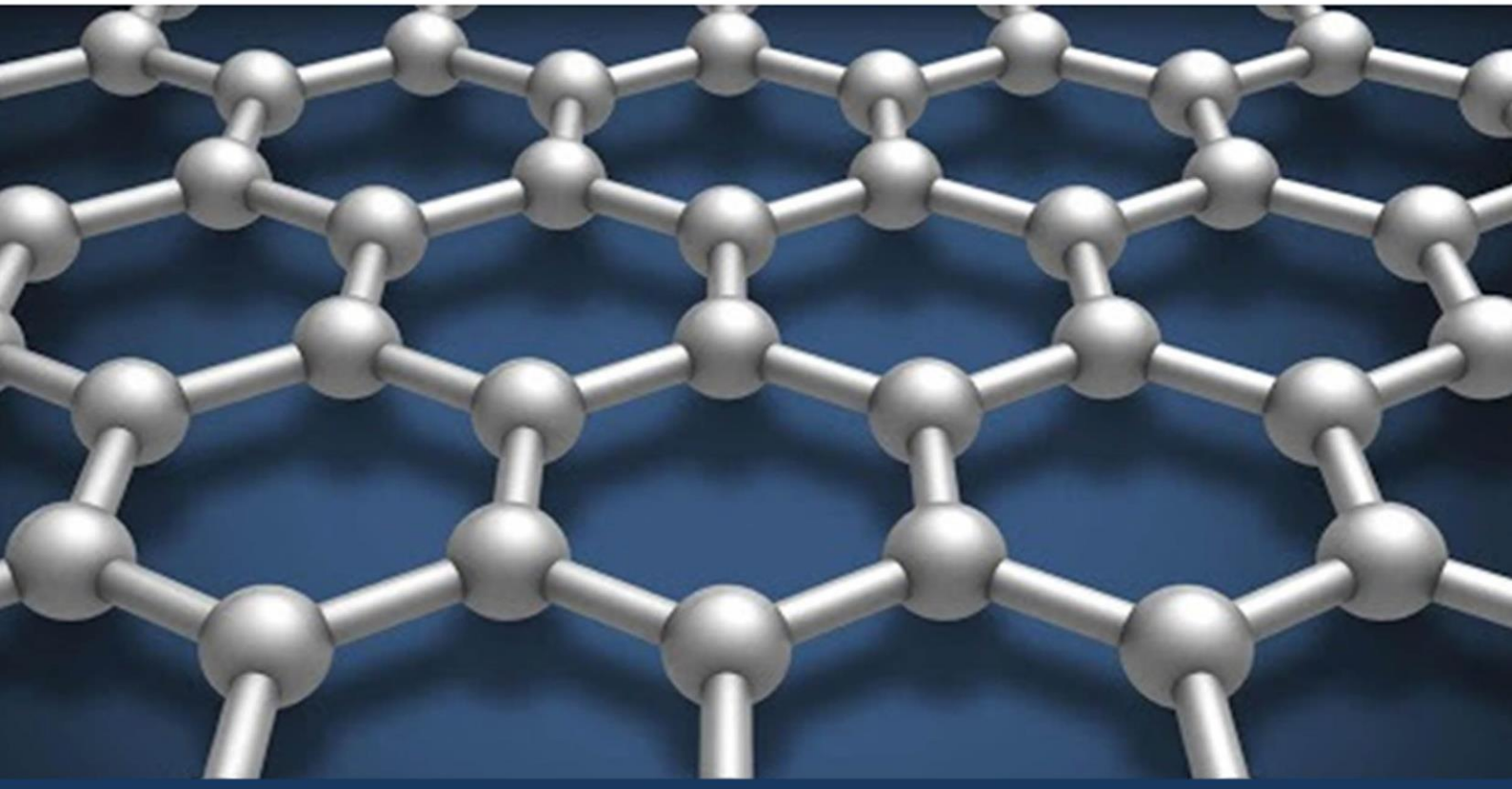

Узбекский научно-технический и производственный журнал

## Композиционные материалы

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# STUDY OF PROPERTIES OF BARHANNA SANDS OF KUSHKUPYR DEPOSIT FOR PRODUCTION OF HEAT-RESISTANT COMPOSITE BASED ON THEM

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**Abstract.** This article studies the chemical-mineralogical, grain composition and physicochemical properties of unenriched barhanna sands located in Kushkupyrsky district. The granulometric composition of barhanna sands is characterized by the predominance of particles larger than 0.007 mm, their fineness modulus is less than one, which allows classifying these sands as fine sands.

**Keywords.** Barhanna sands, heat-resistant composition, degree of fineness.

**Introduction.** In the Republic of Uzbekistan, significant attention is being directed towards the study of the chemical-mineralogical composition, grain size distribution, and physicochemical properties of local raw materials to develop competitive, import-substituting inorganic materials. The rheological, technological, and strength properties of composites are influenced by the mineralogical, chemical, and granulometric composition of the raw materials. To utilize these properties in the development of a heat-resistant composite, the barhanna sand from the Kushkupyr deposit has been studied.

Numerous building materials have been developed using barhanna sands, and their physicomechanical properties have been extensively researched [1-3]. Studies have also addressed the potential for effectively utilizing substandard barhanna sands as a mineral additive [4, 5], as well as the use of processed barhanna sands in the production of building materials [6, 7] and in road construction [8].

The aim of this research is to comprehensively investigate the properties of unenriched barhanna sands from the Kushkupyr deposit to develop a heat-resistant composite material.

**Research methods.** To determine the chemical composition and grain size distribution of barhanna sand from the Kushkupyr deposit, standard methods outlined in GOST 8735-88 [9] were employed.

Chemical Analysis:

An analytical sample was prepared and subjected to analysis using a Scanning Electron Microscope (SEM) EVO MA15 equipped with a Bruker Quantax Energy-Dispersive X-ray Spectroscopy (EDS) system.

Grain Size Distribution:

A standard set of sieves was used to determine the grain size distribution and fineness modulus. A 2000 g sample of sand was dried to constant weight and sieved through sieves with 10 mm and 5 mm diameter openings. The mass of the retained material on each sieve was recorded to calculate the proportion of gravel fractions (5-10 mm). Subsequently, a 1000 g subsample, passing the 5 mm sieve, was analyzed to determine the detailed grain size distribution of the sand.

**Results and discussion.** For the comprehensive study, samples were taken from six sites of the Kushkupyr deposit. The chemical composition of the samples is presented in the table below.

**Table 1**

**Chemical composition of unenriched barhanna sands of the Kushkupyr deposit**

| Samples | Oxide content, wt.% | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **$SiO_2$** | **$AI_2O_3$** | **$Fe_2O_3$** | **CaO** | **MgO** | **$K_2O$** | **$Na_2O$** | **$TiO_2$** | **Total** |
| 1 | 70.39 | 10.10 | 3.99 | 8.75 | 2.14 | 1.72 | 2.42 | 0.47 | 100.00 |
| 2 | 70,65 | 10,21 | 3.92 | 8,95 | 1,90 | 1,68 | 2,11 | 0.46 | 100.00 |
| 3 | 69,85 | 10,74 | 3,96 | 8,75 | 2,22 | 1,64 | 2,36 | 0.46 | 100.00 |
| 4 | 70,89 | 9,91 | 3,58 | 8,68 | 2,13 | 1,70 | 2,64 | 0.47 | 100.00 |
| 5 | 70,32 | 10,14 | 3,64 | 9,08 | 2,12 | 1,84 | 2,37 | 0.48 | 100.00 |
| 6 | 70,04 | 10,11 | 3,79 | 9,06 | 2,18 | 1,77 | 2,55 | 0.47 | 100.00 |
| average | 70.35 | 10.20 | 3.81 | 8.87 | 2.11 | 1.72 | 2.40 | 0.47 | 100.00 |

Analysis of the unenriched sample revealed a significant dominance of $SiO_2$ over other major oxides, including $Al_2O_3$, $Fe_2O_3$, and CaO. The average $SiO_2$ content was determined to be 70.35%. As illustrated in Table 1, sample No. 4 exhibited the highest $SiO_2$ concentration, a finding corroborated by the spectral data presented in Figure 1.

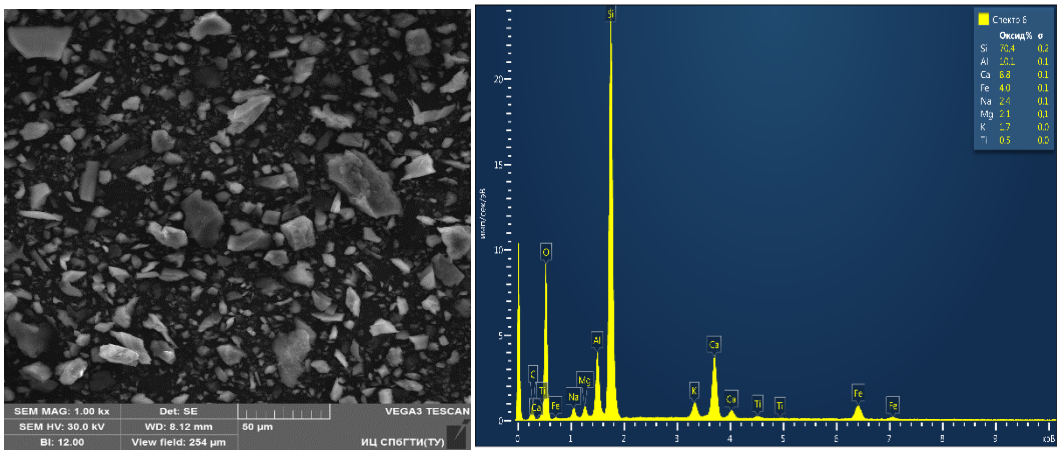


**Fig. 1. SEM image and spectrogram of a sample of unenriched barhanna sand from the Kushkupyr deposit**

Scanning Electron Microscopy (SEM) analysis of barhanna sand particles revealed a dominant quartz composition. The quartz grains exhibited irregular, oval-to-semi-rounded shapes with partially smoothed contours, along with a minor proportion of acute-angled fragments. Additional mineral components identified in the sample included pyroxene, feldspar, and hydromica. To further characterize the mineralogical composition, Infrared (IR) spectroscopy was employed, and the resulting spectrum is presented in Figure 2.

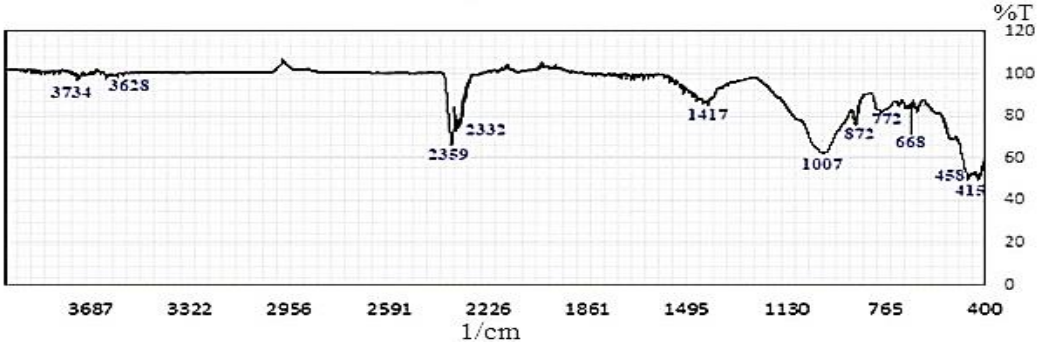


**Fig. 2. IR spectrogram of the barhanna sand of the Kushkupyr deposit**

The analysis reveals that the -OH group is indicated by valence vibrations in the range of 3368 $cm^{-1}$. No deformation vibrations were observed in this range, indicating the absence of adsorbed water in the sample and a high degree of dehydration of the raw material.

In the valence vibration regions of 876 $cm^{-1}$ and 1007 $cm^{-1}$, non-bridging Si–O bonds were observed. Bridging Si–O–Si bonds were detected in the deformation vibration regions of 459 $cm^{-1}$, 777 $cm^{-1}$, and 694 $cm^{-1}$. Bridging Si–O–Al bonds were manifested in vibrations around 1434 $cm^{-1}$. Vibrations in the regions of 591 $cm^{-1}$ and 526 $cm^{-1}$ identified absorption lines characteristic of sodium and potassium feldspars during IR spectroscopic analysis.

**Conclusion.** Therefore, the comprehensive analysis of the Kushkupyr barhanna sand, characterized by its distinct mineralogical, chemical, and granulometric properties, indicates its potential as a valuable component in the formulation of heat-resistant materials. The utilization of this sand as a raw material for heat-resistant materials offers several advantages, including the conservation of clay mineral resources and the mitigation of environmental concerns associated with their extraction and processing.

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