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REFRACTORY MATERIALS FOR CONSTRUCTION BASED ON QUARTZITE

Abstract. Information about the presence and characteristics of existing deposits of high silica and refractory clay raw materials of the Republic of Uzbekistan is given.

It is shown that the main raw materials for the production of silica refractories are veined quartz, quartzites, quartz sands containing not less than 92 wt.% 8i02, and also for packing masses kaolin clays are used, which are promising raw materials.

It is established that the studied quartzite rocks are of great interest and are a promising raw material base for the refractory industry of the Republic of Uzbekistan.

Keywords: quartzite, refractories, kaolinite clay, firing, thermomechanical properties, density.

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Introduction. In the world, production of refractory materials for all industries, the technological processes of which take place at high temperatures, is the main direction of the economy. Consequently, the main consumers of refractory materials – metallurgical, glass, ceramic, cement, energy, chemical industries, materials science, as well as a number of other industries are the main factor of their development [1-2]. In this connection, to ensure their needs, the development of compositions and technology for obtaining refractory materials for various purposes is a priority task.

Research methods and conditions. Investigated Koytash quartzite deposit is located in Djizak region. The quartzites taken from various sites differ from each other by appearance, color and crystal structure.

The peculiarity of this quartzite is its heterogeneous chemical composition, which makes it difficult to use in the production of high-quality silica refractories without enrichment. In Table 1, the chemical compositions of samples of Koytashsky quartzites taken from Kt No.1 (light gray), Kt No.2 (grayish-black), Kt No.3 - mixture of both quartzites). As we can see from table 1 the contents of basic oxides of Koytash quartzites are close to the contents of these oxides of imported Ovruchsky and Pervouralsky quartzites.

The Kt No. 3 are similar to the imported ones and have an average rebirth rate.

The results of determination of physical and mechanical properties of experimental samples from Koytashsky quartzite sare given in Table 2.

Table 1

Chemical composition of Koytash quartzites

Title	Oxide content per air dry matter, mass %								Cl. %
	SiO_2	AI_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	SO_3	
Kt No. 1	95,80	1,10	0,59	0,53	-	0,25	0,50	0,06	1,17
Kt No. 2	98,32	0,21	0,16	0,22	-	0,14	0,56	0,03	0,36
Kt No. 3	95.78	0,20	0,15	0,51	-	0,15	0,58	0,14	2,49
Ovruch	97,3-98,6	0,5-1,4	0,08-0,4	0,2-0,3	0,1	0,17	0,06	0,03	0,01
Pervoural-skoe	98,3-99,0	1,4-0,9	0,4-0,04	0,25	0,09	0,14	0,04	0,01	1,1-0,1

Table 2

Physical and mechanical properties of samples from Koytash quartzites

Title	Meltdowns	Before firing		After firing		Heat resistance,	Fire resistance, °C
		water absorption, %	apparent density, kg/m^3	water absorption, %	apparent density, kg/m^3		
No. 1	1750	0,3-0,4	2610	0,6-0,8	2540	5	1720
No. 2	1750	0,1-0,2	2630	0,8-1,0	2510	5	1730
No. 3	1750	0,2-0,3	2620	0,8-1,0	2530	5	1730

To develop the composition of silica refractory materials, quartzites from the Djerdanak deposit, which is located in the territory of Sherabad district of Surkhandarya region, are also used. The Djerdanak valley divides the deposit into two parts: South and Northern. Subsequent works have established the prospectivity of the northern part, which contains quartz sandstones and clay shales in addition to quartzites. The results of chemical analysis of the Jerdanak quartzites showed that they are more homogeneous than the Koytash quartzites and their silicon oxide content is also comparatively higher [3].

X-ray spectral analysis of samples of quartzites from Koytash and Dzherdanak deposits revealed the presence of 16 chemical elements, of which the main rock-forming elements is silicon, and the rest are present in small amounts. Obtained data X-ray study of unenriched and enriched quartzites from both deposits showed that the difference between them is very small. On both X-ray patterns there are pronounced p-quartz lines (d=0.425; 0.334; 0.245nm). On the X-rays of enriched quartzite these lines are slightly more intense in comparison with unenriched quartzite.

Research results and discussion. In order to develop new compositions of silica refractory masses were studied the influence of plasticizing additives on the main properties ramming masses. As plasticizing components of silicarefractory filling masses on the basis of different compositions in Angren kaolinite clay was introduced into quartzite mixture. Figure 1 shows the results of studying the effect of the amount of added kaolinite clay on linear changes of experimental samples during and firing in charges on the basis of compositions "Djerdanak quartzite-Angren kaolinite clay". The firing temperature was 1400 °C with a holding time of

3 hours. The shrinkage after drying and firing increases in parallel with increasing kaolinite clay content in the charge. At firing, this process continues in charges with clay content of 25 mas.%. Increasing the amount of clay in the charge above 25 mas.% with delayed outgrowth of quartz, because the density of test samples after firing is in the range of 2400-2500 kg/m^3. At the same time, quartz sandstones of these deposits belong to the group with average rate of degeneration, the density of fired samples is in the range of 2400-2450 kg/m^3.

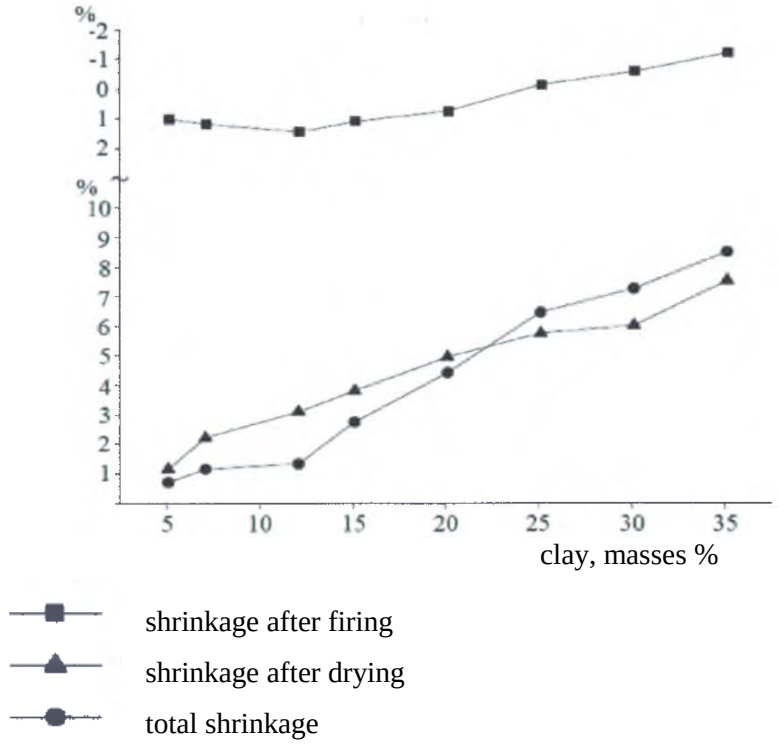

Figure 1. Influence of the amount of clay added on the shrinkage of samples of "quartzite-clay" composition

Clay shale rocks of both sections of the Djerdanak deposit, according to the rate of re-growth, belong to the group of very slow re-growth, whose density is in the area above 2500 kg/m^3. The results of physical and mechanical research of experimental fired samples at 1400°C on the basis of samples Experimental samples in the process of firing reveal the growth as a result of process of quartz rebirth. In charges with clay content above 25 mas.% the growth of quartz mineralto tridymite does not compensate enough the shrinkage of clay, and the samples give shrinkage in the firing process. At the same time it is established thatthe maximum amount of plasticizing additives (added clay)in quartzite charge is 25 mas.%.

Also the results of studying the effects of added Angren kaolinite clay on the mechanical bending and compressive strength of experimental samples for obtaining silica packing masses on the basis of composition "quartzite-clay" are shown in Figure 2.

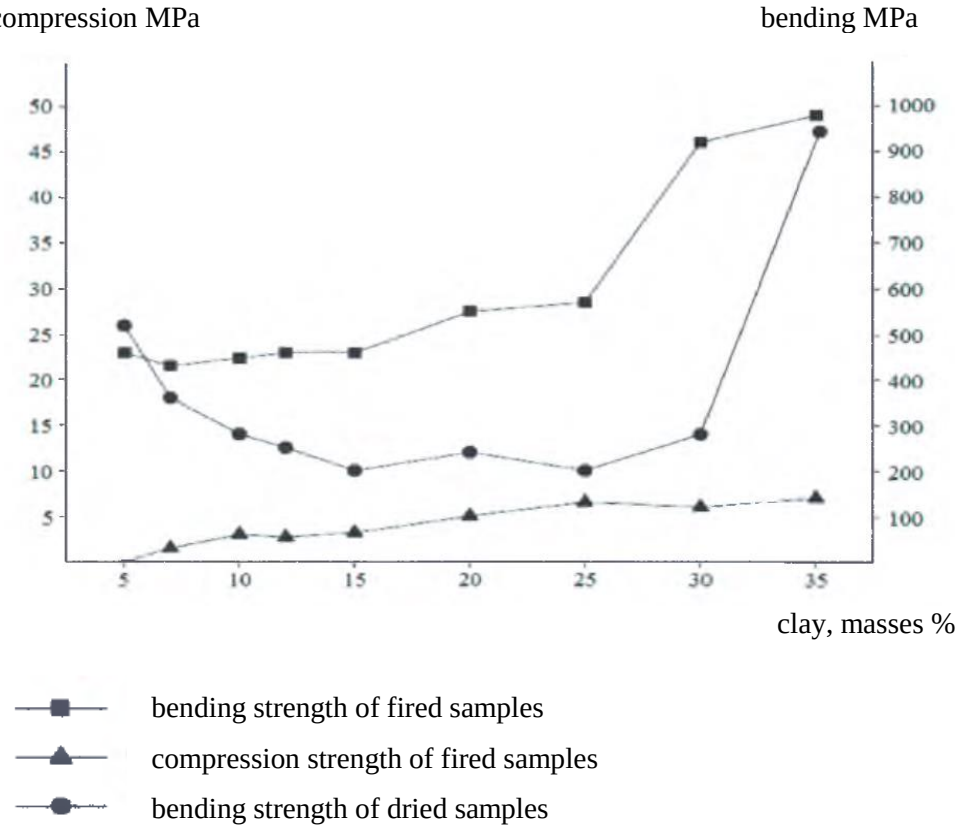

Figure 2. Effect of the amount of clay added on the strength of samples of "quartzite-clay" composition

It was determined that in the charge with the amount of clay above 25 mas%. There is an increase in strength of silica mass due to vitrification refractory shards of the sintering mass in the firing process. Since kaolinite clay is a plastic component, in connection with this,mechanical compressive strength of dried test samples increased continuously with increasing the amount of kaolinite clays. In addition, at high temperature quartz becomes chemically added clay minerals form a liquid phase, resulting in chemical interactions, both through solid phase reactions and with the participation of the liquid phase to form Aluminosilicate (anorthite, mullite) minerals, as well as tridymite, Cristobalite, which have high refractoriness, strength. This explains the production of silica packing masses with improved physical-mechanical and technological properties. In the development of the new composition of silica masses the following researches were carried out the research of partial replacement of quartzite with quartz sand. In order to study influence of Djeroy quartz sand on physical, mechanical and technological properties of quartz-clay masses. Technological properties of quartz-clay batch on the basis of quartzites Jeredanak and Angren clay were prepared test samples, in which the sand content varied from 25 to 50 mas.%. The developed compositions of the charge and thermomechanical properties of the experimental samples 1450°Care shown in Table 3.

Table 3

Resin composition and thermomechanical properties of experimental samples

No.	Charge composition, mass %			Fire shrinkage, or growth ,%	Porosity, %	Strength at bending strength, MPa
	quartz	clay	quartz sand			
1	85	15	-	+1,45	26,14	2,58
2	60	15	25	+1,25	22,82	3,18
3	55	15	30	+1,07	24,05	2,47
4	45	15	40	+1,02	26,52	1,54
5	35	15	50	+0,98	31,25	0,58
6	75	25	-	-0,29	25,85	3,04
7	50	25	25	-0,26	25,05	3,96
8	45	25	30	-0,21	26,14	2,77
9	35	25	40	-0,18	27,05	2,04
10	25	25	50	-0,16	27,98	1,85

The results of experimental studies have shown that when introduction into the quartz-clay mass of Djeroy quartz sand fireshrinkage is reduced as a result of the lower ability of the quartz sandability of this quartz sand to overgrow. In case of larger quantities of Djeroy sand in of experimental samples with increasing porosity the compressive strength decreases. It is established that the replacement of Jerdanak quartzitesilica sand in large quantities, above 25 mas.%, in the masses for filling the charge also leads to deterioration of the thermomechanical properties of the samples.

Conclusion. In general, on the basis of the studied quartzites of the Koytash and Jerdanak deposits mixed with kaolinite clay and limestone, as well as with the partial replacement of quartzites with quartz sand, printed masses with a wide range of physical chemical and technological properties were obtained.

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КВАРЦИТ НЕГІЗІНДЕГІ ҚҰРЫЛЫСҚА АРНАЛҒАН ОТҚА ТӨЗІМДІ МАТЕРИАЛДАР

Аңдатпа. Өзбекстан Республикасының ресурстары жоғары кремнийлі және отқа төзімді сазды шикізат кен орындарының сипаттамалары туралы ақпарат беріледі Динас отқа төзімді заттарды өндірудің негізгі шикізаты өзекті кварцтар, кварциттер, кварц құмдары болып табылады құрамында кемінде 92 масс.% SiO_2, бар сондай-ақ басылған массалар үшін перспективалы шикізат болып табылатын каолин саздары қолданылады. Зерттелетін кварцит жыныстары Өзбекстан Республикасының отқа төзімді өнеркәсібі үшін перспективалы шикізат базасы болып табылатыны анықталды.

Тірек сөздер: кварциттер, отқа төзімді заттар, каолинит сазы, күйдіру, термомеханикалық қасиеттері, тығыздығы.

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ОГНЕУПОРНЫЕ МАТЕРИАЛЫ ДЛЯ СТРОИТЕЛЬСТВА НА ОСНОВЕ КВАРЦИТА

Аннотация. Приводится информация о наличии и характеристиках существующих месторождений высококремнеземистых и огнеупорных глинистых сырьевых ресурсов Республики Узбекистан. Показано, что основным сырьем для изготовления динасовых огнеупоров являются жильные кварцы, кварциты, кварцевые пески, содержащие не менее 92 масс.% SiO_2, а также для набивных масс используются каолиновые глины, которые являются перспективным сырьем. Установлено,что исследуемые кварцитовые породы представляют большой интерес и являются перспективной сырьевой базой для огнеупорной промышленности Республики Узбекистан.

Ключевые слова: кварциты, огнеупоры, каолинитовая глина, обжиг, термомеханические свойства, плотность.