APPLICATION OF EFFECTIVE SUBSTITUTES FOR FELDSPARATE MATERIALS IN THE CERAMIC INDUSTRY

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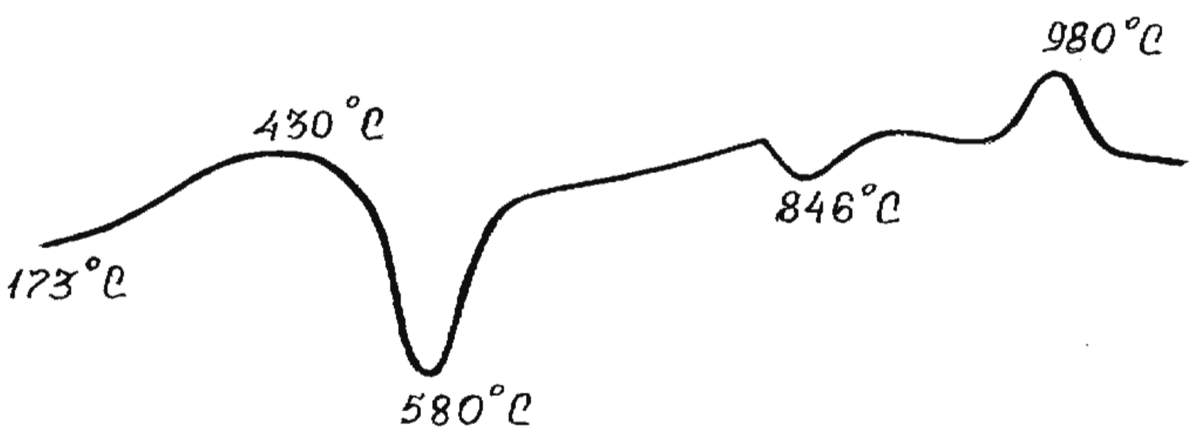
Abstract. *The studies of many scientists on the use of various man-made wastes have established the possibility of their use in the ceramic industry. The mutual influence of industry and the environment acts as a component element of the ecological system "man - nature". The increase in mining, the development of metallurgical production and thermal power engineering has led to a significant accumulation of various types of waste that are generated both in the process of mining and beneficiation of minerals, and at various stages of their processing. The Kaitash tungsten-molybdenum plant produces molybdenum and a large amount of solid waste is generated during the flotation process. The aim of the study is to study the chemical and mineralogical composition of this waste and to explore the possibility of using it in the ceramic industry, in particular for the production of ceramic masses and glazes.*

Keywords: *Industrial waste, ecology, refractoriness, feldspar, pegmatite, organic impurities, water of crystallization.*

Today, it is becoming extremely important to ensure the maximum possible protection of the environment from industrial facilities, which, consuming huge amounts of natural resources, are powerful sources of pollution. The mutual influence of industry and the environment acts as a component element of the ecological system "man - nature". The increase in mining, the development of metallurgical production and thermal power engineering has led to a significant accumulation of various types of waste that are generated both in the process of mining and beneficiation of minerals, and at various stages of their processing [1]. The soil is polluted by solid waste from the metallurgical industry. They accumulate on areas of land measuring hundreds of hectares. Heavy metals tend to accumulate in soil, water, plants, food, the human body, etc. Metals entering the environment are divided into three hazard classes; the moderately hazardous class includes the following - nickel, cobalt, copper, chromium, molybdenum, etc. Metallurgical plants and complexes occupy an area of more than a thousand hectares, the main part of which is occupied by dumps, sludge reservoirs and other waste. They penetrate into the soil under the influence of precipitation, and this area becomes unsuitable for agriculture. The environmental problem causes millions of losses to the economy, and also affects the human body, leading to pulmonary, oncological, vegetative-vascular lesions, disorders of the musculoskeletal system, diseases of the skeletal system, dermatitis, etc. Research by many scientists on the use of various man-made waste has established the possibility of their use in the ceramic industry. The Kaitash tungsten-molybdenum plant (KWMP) produces molybdenum and the flotation process generates a large amount of solid waste. The purpose of the study is to study the chemical and mineralogical composition of this waste and to study the possibility of using it in the ceramic industry, in particular for the production of ceramic masses and glazes.

Unlike many other manufacturing industries, the ceramics industry is able to reuse within its production the bulk of its own waste, which is generated at a certain stage (often as waste) of production [2]. In this way, it is possible to avoid the extraction, transportation and use of thousands of tons of materials of natural origin, such as sand, feldspars, aluminum oxide, zirconium oxide, mullite, clays. The use of effective substitutes for feldspathic materials in ceramic masses often improves the physical and technical technological properties of ceramic materials, since they have a similar chemical composition to the raw materials [3]. The chemical composition and particle size distribution of solid waste from the Kaitash tungsten-molybdenum factory have been studied. Waste samples obtained at different times of the year were studied by X-ray, thermographic and other methods of analysis.

According to the obtained DTA data of the initial flotation waste (Kaitash tungsten-molybdenum production), the endothermic effect at 173^0C on the thermal curves characterizes the removal of hygroscopic water. The exothermic effect at 430^0C corresponds to the burning out of organic impurities. Endothermal effect at 580^0C is caused by the removal of water of crystallization and partial destruction of the kaolinite crystal lattice, and the endothermic effect at 846^0C is caused by polymorphic transformations of quartz. The endothermic effect with a maximum at 980^0C is accompanied by the appearance of new phases - mullite and anorthite. The diffraction pattern of the flotation waste reveals the following phases: quartz d/n = 0.421; 0.3350.180 nm; kaolinite 0.511; 0.197 nm; wollastonite d/n = 0.317; 0.287; 0.197; 0.148 nm, hydromica d/n = 0.511; 0.335; hematite d/n = 0.269; 0.251; 0.227; 0.186 nm.



Drawing 1. DTA of the initial flotation waste from the Kaitash tungsten-molybdenum factory.

The infrared absorption spectra of the Kaitash flotation waste tungsten - molybdenum ores are characterized by the presence of absorption bands at wave numbers 1050, 940, 910, 680, 650 cm^{-1} related to the quartz-like framework [Si(Al)O_4]. Csymmetric Si-O-Si stretching vibrations are observed at 810 cm-1, indicating the existence of $[Si_3 0_9]^{6-}$ ring anions. The bands at 1050 and 450 cm^{-1} characterize the as AI–O –Al frequencies; the absorption bands in the region of wave numbers 540 and 450 cm^{-1} refer to the stretching vibrations of Fe-0-Fe. These absorption bands are also observed in the infrared spectrum of natural hematite at 810 cm^{-1}, they are attributed to the bending vibration of the Fe-O bond. Thus, the characteristics of the Kaitash flotation waste from the enrichment of tungsten-molybdenum ores show that, based on the $AI_2 0_3$ content, it can be classified with some approximation into various classes of fire resistance; based on the CaO content, one can judge the deformation temperature of the products; based on the Fe_2O_3 content, the color of the fired products; based on the SiO_2 and alkalis Na_2O and K_2O - on the fusibility of raw materials and the strength of finished products[4]. Using the mass crystallization method, scientists studied the effect of AL_2O_3 and MgO on the crystallization ability of glasses and the following was established: AL_2O_3 does not weaken the crystallization ability of glass in all cases; an increase in the amount of alkalis weakens the crystallization ability; ceramics containing many components have crystallization ability to a lesser extent; An increase in MgO increases the crystallization ability of glass. it should be no more than 10% (even if AL_2O_3 and other components are present); containing MgO over 11%, and alkalis less than 14%, the crystallization ability is manifested to a greater extent. In order to study the sintering processes and the possibility of producing ceramic tiles based on the above composition, series were prepared; in the production of experimental masses, raw materials were used, the compositions of which are given in Table 1.

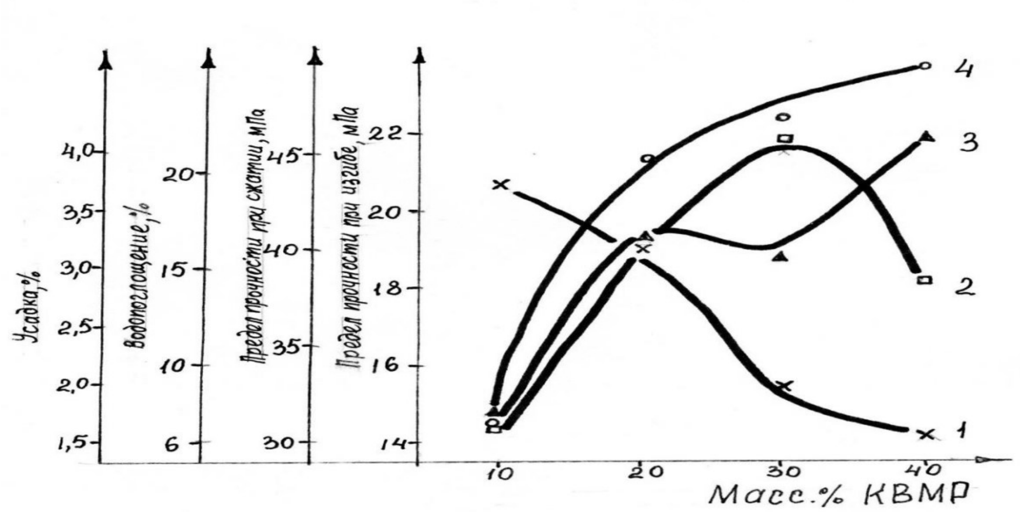
It should be noted that with a simultaneous change in the content of all components in the composition of the masses (compositions M-11 ÷ M-15), an uneven and insignificant change in the properties of the sintered samples is observed.

Table 1.

Material composition of experimental ceramic masses

Components, mass. %	Mass index:														
	M-1	M-2	M-3	M-4	M-5	M-6	M-7	M-8	M-9	M-10	M-11	M-12	M-13	M-14	M-15
Enriched angren kaolin	50	50	50	50	40	30	20	10	50	40	40	30	35	40	50
Gliège angrensis	10	20	30	40	50	50	50	50	50	40	35	35	25	30	25
KVMR	40	30	20	10	10	20	30	40	0	20	25	35	40	30	25

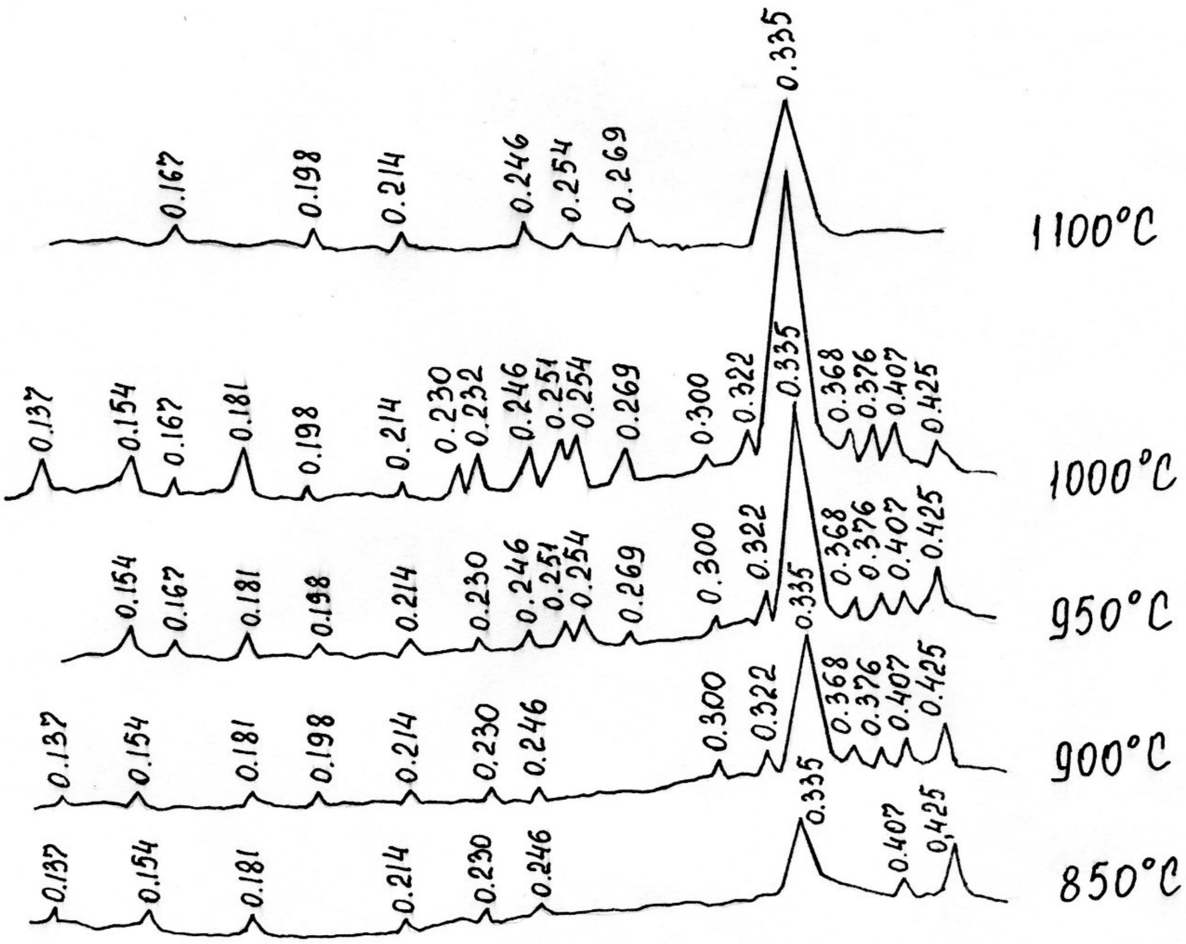
It has been established that the introduction of CVMR leads to significant reduction in water absorption (Fig. 3), increase density and strength of fired samples at different temperatures, i.e., the effect of intensified sintering occurs for everyone studied ceramic masses, but the agnitude of the achieved effect different.



Drawing. 3. Change in water absorption (1), tensile strength at compression (2), shrinkage (3) and flexural strength (4) ceramic samples depending on the CVMR content.

As can be seen from the data presented, the indicators of the properties of the studied samples in an air-dry state depend on the composition of the ceramic wt. It is known to use raw materials with a high content of iron oxide in the production of ceramic products, which significantly affects the formation of the structure of the glass phase and ensures a reduction in the temperature of appearance of the liquid phase by 50 – 70^{0}C.

Physico-mechanical and technological properties of samples from experimental masses fired at different temperatures are given in table 1. indicates that the physical and mechanical properties of sintered samples ceramic masses largely depend on the content input components (KVMR, gliezha) and firing temperature. It should be noted that with a simultaneous change content of all components in the composition of the masses (compositions M-11 ÷ M-15) there is an uneven and slight change in properties sintered samples. As a result of determining chemical stability. samples of the "kaolin-gliege-KVMR" system when exposed to solution of concentrated H_2SO_4 and 20% NaOH, it was found that as increasing the content of CVMR, an increase in acid resistance is observed samples from 97.04 to 98.72% and alkali resistance from 96.35 to 97.45% Therefore, increasing the amount of KVMR flotation waste to 40% leads to significant glass formation. Using an optical microscope, porous glass of various compositions was discovered, which is apparently due to the intensification of glass formation in the presence of a high content of up to 40% increase in the amount of flotation waste KVMR, which introduces a large amount of iron oxide into the ceramic mass.



Drawing. 2. Diffraction patterns of samples from mass M-2, fired at different temperatures.

In order to develop a method for recycling flotation waste and the possibility of producing facing tiles based on Angren kaolin clays, flotation waste and gliege, it was planned to develop a ceramic base with improved physical and mechanical properties.

The use of production waste in the ceramic industry, in particular from the Kaitash tungsten-molybdenum production, makes it possible to reduce the consumption of scarce raw materials, as well as reduce the harmful impact of industrial waste on the environment, and increase the economic performance of production. The main direction of protecting the natural environment today is to maintain the maximum possible ecological balance and ensure the natural relationships of the ecosystem. Ecology has traveled a difficult and lengthy path to understanding the “man-nature” problem, relying on research in the “organism-environment” system.

REFERENCES

1. У. Б. Александрович и др., Экология и производство строительных материалов. Системные технологии, журнал- 2015 -№1/22 С.84-88.
2. Вторичные сырьевые ресурсы в производстве строительных материалов. Справочное пособие. Под. Ред. А. В. Долгорева. – М.: Стройиздат, 1990. – 496 с.
3. Мухамеджанова М.Т. Флотоотход свинцово-цинковой фабрики в плиточных композициях // Стекло и керамика. 1996. – № 10. – С.21-23.
4. Макаров Н.А., Свердликов В.Л. Композиционный материал системы корунд – диоксид циркония – спекающая добавка. // Стекло и керамика. 2005. – № 11. – С. 8-10.
5. Артиков А., Мухамеджанова М.Т.. Отходы промышленности для получения керамических плиток // Строительные материалы. 2003. – № 2. – С. 52-53.
6. Левицкий И.А., Дятлова Е.М., Особенности формирования контактной зоне в системе глазурь – керамика // Стекло и керамика. 2000. – № 1. – С.18 – 22.
7. Пилипчатин Л.Д. Спекание шамотно-каолиновых масс с тугоплавкой глиной // Стекло и керамика. 2000. – № 6. – С. 25-27.