СТРОИТЕЛЬНЫЕ МАТЕРИАЛЫ / CONSTRUCTION MATERIALS

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ПРОИЗВОДСТВО СТРОИТЕЛЬНОЙ КЕРАМИКИ ИЗ ПРОМЫШЛЕННЫХ ОТХОДОВ

Научная статья

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Аннотация

Приведены обобщенные данные по синтезу керамических материалов на основе флотоотходов. Разработаны оптимальные структуры керамики для облицовочных плиток и получения технологических параметров из спеченных материалов на основе композиции Каолин-шамот-флотоотход КВМФ. Определены физико-химические свойства спеченных образцов.

Ключевые слова: керамический материал, спекание, физико-химические свойства.

MANUFACTURE OF THE BUILDING CERAMICS FROM AN INDUSTRIAL WASTES

Research article

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Abstract

The generalized data on the synthesis of ceramic materials are presented based on float waste. Optimum structures of the ceramic are developed for facing tiles and technological parameters receptions of sintered materials on the basis of a composition "Kaolin- chamotte- wastes of the flotation of tungsten-molybdenum ores of Kaitash".

Keywords: ceramic materials, sintering, physicochemical properties.

In majority of cases the modern technology of refractory, ceramic, binding, oxide and some of others materials manufactures is based on difficult physical and chemical processes proceeding in multicomponent compositions at high temperature. Physical and chemical processes, occurring in the first period of thermal processing of ceramic masses, make basis of all ceramic technologies. Use of a waste of ferrous metallurgy, chemical and machine-building manufactures, ash slags of thermal power station at manufacturing of facing tiles allows to improve essentially their quality indicators. However, the wastes of the non-ferrous metallurgy in manufacture ceramic tiles practically are not applied.

In the literature are resulted negative influence of the iron oxide containing in raw materials because it stain the crock [1], besides, it is marked that iron oxide is acting as flux during ceramic masses are baked [2].

For the purpose of studying of processes of baking and possibility to obtain ceramic tiles on the basis of a compositions of the natural raw materials and industrial wastes (kaolin-chamotte –wastes of the flotation of tungsten-molybdenum ores of Kaitash - KTMO) was prepared a series of the trial masses, which chemical compounds are resulted in tab.1.

Table 1 – Chemical content of initial materials

Initial materials	SiO_2	$A1_20_3$	CaO	Mg0	FeO	Na_2O	K_2O	$S0_3$	ППП
Kaolin(Angren)	62,30	23,40	1,26	0,20	1,84	0,10	0,60	0,46	9,96
Chamotte	65,81	29,26	0,84	0,36	1,64	0,44	1,10	-	-
KTMO (wastes of the flotation of tungsten-molybdenum ores of Kaitash)	42,15	8,62	19,0	4,5	13,4	0,44	0,21	0,02	11,2

*ППП - losses during heating

As initial substances have served: kaolin of Angren deposit, chamotte and the waste of the flotation of tungsten-molybdenum ores(KTMO). Chamotte are used in quality of filling aggregate, and KTMO component played role of fusing agent.

Samples for trial was made by soft-mud process. Fashioned samples were content humidity of 22 %, they were dried and charred in special furnaces at temperature - round 800-1000°C and then was defined their physic and mechanical properties as strength, density, shrinkage, water absorption. The results are shown in tab. 2.

Table 2 – Technological properties of the trial ceramic samples

Indexof samples	Content,%			Volume density,kg/m^3	Flexural strength, MPa	Air shrinkage,%
	Kaolin	KTMO	Chamotte			
1f	70	25	5	1630	1,20	4,80
2f	60	35	5	1620	1,15	4,20
3f	50	46	4	1590	1,13	3,80
4f	45	50	5	1580	0,90	3,12
5f	40	55	5	1600	0,86	2,75

The analysis of the data shows that the physical and mechanical properties of sintered samples of ceramic masses depend on the maintenance of KTMO quantity and fire temperatures.

So, at the constant maintenance of chamotte (structures 1f, 2 f, 4f, 5f) and sintering temperature 950°C with increase of quantity of KTMO and simultaneous reduction of kaolin clay fire shrinkage of the samples are raised from 5,4 to 6,1 %, and we can see growth of the mechanical durability and density of samples.

At heats and the raised maintenance of KTMO the sintering processes are intensified due to formation of the liquid phase providing increase of density and durability of samples. However with increase quantities of KTMO to 55 % and temperature till 1000^{0}C these properties are worsen. Water absorption of 16, 9 % increases and go down indicators of strength.

Results of research of physical and mechanical properties of samples have shown that optimum quantity of the waste KTMO it is possible to consider from 40 to 50 %. At such maintenance of KTMO probably to receive ceramic masses for facing tiles with improved physical and chemical properties. The physical and chemical processes occurring at baking of ceramic samples was defined by different methods (X-rays, complex spectrographic analysis).

It is known application of raw materials with the raised maintenance of ferrous oxide in manufacture of a stoneware, which essentially influences on structure formation of glass phase and provides a temperature reduction of occurrence of a liquid phase during temperature 50-70°C [3]. Therefore increase of quantity of KTMO to 46 % leads still to formation of glass phase. By means of an optical microscope it is revealed porous glass of various structures. Probably, an intensification of the glass phase at quantity increase of KTMO to 46 % it is due to the raised maintenance of ferrous oxide.

On the radiogram of the sample from mass 3ф, charred at temperatures above 900^o C it is possible to note the phases of wollastonite and anorthite wich was formed in an initial stage process.

Results of X-ray analysis show that at fire temperature 800-900°C starts to form $CaO{\cdot}Al_2O_3{\cdot}SiO_2$ (anorthite), $CaO{\cdot}SiO_2$ (wollastonite), and their quantity increase depend on rise of fire temperature of the samples.

Anorthite formation process proceeds with raise of the speed that proves to be true occurrence on radiogram anorthite intensive lines, and this is the reason of high temperature shrinkage and sealing of the material.

Changing of the phase composition of ceramic masses at optimum temperature (950^{o}C) promotes improvement of their physical and mechanical properties (Tab. 2). During this process water absorption is sharply decreases and shrinkage is insignificantly increased. Apparently formation of wollastonite and anortite reduces growth of shrinkage and flexural strength increase more than on 25 %. Due to liquid phase are occurred in samples when fire temperature is above 1000°C intensity of lines of all matters on radiogram is decreased. It is testifies to their constant dissolution in melt and all it visually proves to be true by material deformation.

As a result of the spent researches of structures of ceramic samples it is established, that the main part of ceramic samploes is presented by wollastonite, anorthite, hematite and quartz.

It is established that investigated waste material KTMO can be used as the basic raw material for the new structures of ceramic materials. In particular, optimum structures of the ceramic are developed for facing tiles and technological parameters receptions of sintered materials on the basis of a composition “Kaolin- chamotte- KTMO”.

It is established that using of waste KTMO in structure of ceramics will allow to expand a raw-material base of the ceramic manufactures and to decrease temperature of baking and the cost price of the ceramic materials and products.

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