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Some Aspects Of Studying Clays For Producing Ceramic Brick Of Required Properties

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ABSTRACT

This article aims to show what research needs to be carried out not only to understand the nature and establish the potential capabilities of clay raw materials, to guide technologists, what stages of testing should be organized in production and at what stages it is advisable to consult a specialist in order to develop a technically competent and optimal composition of ceramic bricks.

A program for testing clay raw materials is described, which should be developed in such a way as to obtain the most complete information about this clay, its composition, properties, behavior during technological processing: molding, drying and firing during research. And also an explanation is given about the measures necessary before the start of the tests, it is advisable to have information about the geological surveys of the field, about the previously conducted studies and, if the plant has already been built and operated, about the problems that do not allow the production of products of the required quality.

KEYWORDS

Ceramic bricks, raw materials, clay, mineralogical composition, clay-forming, carbonate, insensitive, dilatometric analysis, sintering capacity.

INTRODUCTION

Improving the quality of ceramic materials remains an important task for many factories in our country. Currently, manufacturers produce low quality products not only due to the deterioration of equipment, but also due to insufficient knowledge of the quality indicators of raw materials and poor development of the main technological stages of manufacturing the final product - ceramic bricks.

Methods for determining the properties of clay. Various methods of clay testing, developed by a large number of scientists and practitioners, are designed to greatly facilitate this work and help to most effectively use the potential of clays to obtain quality products.

Macroscopic description of samples of clay raw materials is carried out in order to determine the appearance, macrostructure, color and density of clays. At the same time, the presence of inclusions and the degree of boiling of the sample when interacting with a solution of hydrochloric acid are also recorded. [1]

Clay minerals are mainly hydrated aluminosilicates of calcium, magnesium, iron, etc. and impurities. Therefore, traditional chemical analysis gives the first general idea of the composition of raw materials and some future properties of products. So, by the amount and dispersion of quartz, one can judge the strength indicators and drying properties; by the amount of coloring oxides, in particular iron oxide in combination with the content of calcium and magnesium oxides - about the color of the shard from this raw material; by the amount of calcium oxide, magnesium and carbon dioxide - about the amount of impurities of calcite and dolomite; by the amount of aluminum oxide in combination with the content of sodium, potassium and iron oxides - about the behavior of clay during heating; by the amount of calcium and magnesium oxides - about the behavior of the ceramic shard during firing in the temperature range of 700-1000 0C and over 1050-1100 0C.

The composition and amount of water-soluble salts in clay gives an idea of whether efflorescence and efflorescence will appear on the surface of products, and allow the selection or development of methods for their elimination.

It is necessary to investigate the mineralogical composition of the raw material - which clay minerals form this raw material, which specific impurities are present in the clay.

Typically, clay has a polymineral composition, and several clay-forming minerals with different technological properties are simultaneously present in it. So, for example, the presence of kaolinite in the raw material increases the refractoriness of products and obliges to pay special attention to the modes of molding and firing of products.

In nature, however, clays with one mineral in their composition are rarely found, therefore they are classified according to the predominant content of one or another mineral.

In general, this group of research methods gives an idea about the material composition of clay raw materials and partly about the future properties of products.

At the next stage, it is necessary to analyze the properties of clays. The content of coarse-grained inclusions is determined by washing the sample on a 0.5 mm sieve, followed by sieving on sieves 5, 3, 2 and 1 mm. This analysis gives an idea of the content in the sample of large solid inclusions: quartz, carbonates,

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organic matter, etc. At this stage, the content and activity of large carbonate inclusions is also determined. The results of this analysis are used when deciding on the required degree of dispersion of the initial clay raw material. [five]

To obtain information on the properties of the clay component, a granulometric analysis is carried out using the pipette method, which makes it possible to determine the particle size of the clay raw material. So, clay minerals with sizes of several microns or less will naturally be found in fractions of 0.005-0.001 and less than 0.001 mm, and for example, free quartz - in the largest fractions (over 0.01 mm). To determine the qualitative and quantitative composition of clay raw materials in the future, the data obtained using other analyzes are compared with the results of the granulometric analysis.

According to the plasticity number, clays are classified as highly plastic with a plasticity number of more than 25, medium plastic - 15 ÷ 25, moderate plastic 7 ÷ 15, low plastic less than 7 and non-plastic, which do not give plastic dough at all. The plasticity index correlates with the granulometric composition of the clay and, naturally, with the mineralogical composition, that is, with the content of clay matter in the raw material.

The study of the drying properties of raw materials occupies a very important place in laboratory and technological research by the method of plastic molding. The drying properties of clays are directly related to the amount of montmorillonite. The more it is, the higher the sensitivity of the raw material to drying. However, this statement applies to clays with a total clay content of at least 30-40%. In the case of a lower content of clay matter, cracks during drying are also often noted, but this occurs due to insufficient binding capacity of the mass, and then they talk about a relatively large amount of dusty particles. In our opinion, it is more correct to speak not about dusty particles in general, but about the content of the mineral component (quartz, calcite, feldspars, etc.), represented by particles of appropriate sizes. [5]

In practical work, when determining the sensitivity of raw materials to drying, two methods are most often used - A.F. Chizhsky and Z.A. Nasovoy [5]. According to the accelerated method of Chizhsky, a formed plate of a sample with dimensions of 55 x 55 x 10 mm is irradiated with a powerful heat flux until cracks appear on the plate. The time of the appearance of the first crack (in seconds) is the criterion for the sensitivity of clays to drying.

This relatively simple and fast method allows to some extent assess the sensitivity of clays to drying and conditionally classify them into one of three groups: highly sensitive to drying clays, when cracks appear before 100 s of irradiation, moderately sensitive - cracks appear after 100-180 s and insensitive when cracks appear in more than 180 s.

Also, the sensitivity of clay raw materials to drying can be carried out using the method, which consists in the direct determination of the amount of montmorillonite in the raw material. Clay minerals, kaolinite or hydromica, do not make the clay highly sensitive. The sensitivity of raw materials to drying is increased only by montmorillonite-like minerals that have interlayer water in their structure and are removed at temperatures up to 2000C. When removed, the lattice parameters of montmorillonite change

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accordingly from 24 to 10. This explains the inevitable appearance of microcracks, which causes the use in this case of various technological methods to reduce their negative impact on product quality (introduction of a weaker, softening the drying time, etc.). [6]

It should also be taken into account that this indicator refers to clays with a total clay content of at least 30-40%. In the case of a lower clay content, it does not reflect the actual sensitivity to drying of the clay.

In our opinion, knowledge of such characteristics as critical humidity is very useful, but the method for determining it is clearly imperfect, since drying is carried out at a temperature of 1000C. It should also be noted that in this case the drying process differs from drying at lower temperatures and higher humidity, in particular, shrinkage is significantly reduced (one and a half to two times).

More reliable results can be obtained by the Bigot method [3], which involves drying in natural conditions or under the influence of a small air flow. In this case, the data on shrinkage coincide with the data obtained during further tests.

In addition to these laboratory-analytical methods for studying the drying properties of clay raw materials, a laboratory tube-dryer is used, which makes it possible to dry samples at different temperatures, the rate of supply of the coolant and its relative humidity. Analysis of the nature of cracking plays an essential role in choosing the composition of the charge, determining the safe parameters of drying and other technological modes.

In the study of the firing process, dilatometric analysis is also used, and the sintering capacity and refractoriness of the feedstock are determined.

Sintering capacity is the ability of a ceramic shard to have a water absorption of less than 5% in a certain temperature range without the appearance of deformations (swelling, melting). This indicator is little used in the brick industry, since the vast majority of clays are non-caking. However, information about the change in density and water absorption with an increase in temperature is necessary.

Refractoriness is the property of ceramic materials to resist high temperatures without melting. Clays for the production of ceramic wall materials are predominantly fusible. Dilatometric analysis is very important for choosing the optimal firing modes for ceramic products. [7]

RESULTS

Kuva-1 field Soils in the study area are characterized by a solid residue of 10763-16200mg / kg; the content of Cl'-304-372mg / kg ions; ions SO4 "-5768-8980mg / kg

Description of characteristics	Unit rev.	Regulatory meaning	Calculated values at α =	
			0,85	0,95
Soil density	t / m3	1,90	1,89	1,87
Density of soil particles	t / m3	2,71		
Specific gravity of soil	kN / m3		18,5	18,3
Specific gravity of soil, taking into account the weighing effect of water	kN / m3	-	8,7	8,5
Moisture at yield point	дол.ед.	0,320		
Plasticity number	дол.ед.	0,11		
Indicator of fluidity	б/р	0,76		
Specific adhesion	kPa	12,0	7,0	4,0

The soil is moderately plastic with poor sinterability, melting is observed.

Buvaida-2 field Soils in the study area are characterized by a solid residue of 5000-5100mg / kg; the content of ions Cl'-230-300mg / kg; ions SO4 "–2720-2970mg / kg

Description of characteristics	Unit rev.	Regulatory meaning	Calculated values at α =	
			0,85	0,95
Soil density	t / m3	1,92	1,91	1,90
Density of soil particles	t / m3	2,70		
Specific gravity of soil	kN / m3		-	-
Specific gravity of soil, taking into account the weighing effect of water	kN / m3		8,9	8,8
Moisture at yield point	дол.ед.	0,296		
Plasticity number	дол.ед.	0,088		
Indicator of fluidity	б/р	>1,0		
Specific adhesion	kPa	12,0	7,0	4,0

The soil is moderately plastic with poor sinterability, there is a bulging

CONCLUSIONS

The information obtained as a result of the research carried out shows that sufficient knowledge of the properties of clay makes it possible to develop technological regulations for the production of ceramic products with a set of predetermined properties. For example, with a more gentle drying mode, it is possible to prevent melting of the product while maintaining the strength characteristics.

Correct planning of the final stage - laboratory and technological research, the purpose of which is to select a charge, obtain specific data on the molding, drying and firing properties of the selected charge, strength characteristics of products, their durability, frost resistance, architectural expressiveness, etc., allows you to obtain high-quality ceramic bricks.

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