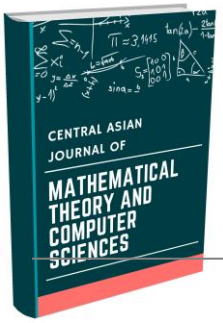

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PHYSICAL AND MECHANICAL PROPERTIES OF ARTIFICIAL LIGHTWEIGHT AGGREGATES PRODUCED IN UZBEKISTAN

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Annotation

The article presents information about the explored deposits of raw materials for the production of expanded clay in the territory of the Republic of Uzbekistan, about their reserves, as well as the results of studies of the study of the physical, physical and mechanical properties of products of enterprises producing expanded clay.

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Introduction

Large-scale work has been determined in our republic to further develop the construction industry and the production complex of building materials, ensure the construction of affordable housing for the population in the regions, and reduce the imbalance in supply and demand in the housing construction market [1]. At the same time, the building materials industry has taken comprehensive measures to use energy and natural resources, save them, produce energy-efficient building materials that replace imports from local raw materials, and produce materials at the level of demand based on the intended use of raw materials in production. The acceleration and particularly rapid growth of the housing construction sector requires increased requirements for the development and modernization of the building materials industry, the building complex of our country. In this regard, expanded clay and expanded clay are rightfully considered promising materials due to their high strength, environmental safety and reliability, as they served as the basis for solving the housing issue in the former union territory in the 60s and 80s of the last century. Its widespread use ensured the acceleration of construction time, the rapid construction of residential, public and industrial buildings, the reduction of labor costs, and the increase in the level of mechanization of construction work [2]. It is a pity that by now we see that the use of expanded clay and expanded clay concrete in construction has somewhat decreased.

The main raw materials for the production of expanded clay are bentonite-argillite-like clays and mudstones belonging to the Jurassic, Cretaceous and Paleogene periods. Bentonite-like clays require the introduction of organic additives during the cooking of expanded clay. As of 01.01.2013, the state balance of mineral reserves on the territory of the Republic of Uzbekistan takes into account the reserves of expanded clay in 16 mines with a total reserves of 20,894 thousand m^3 [3].

According to the association "Uzsanoatkurilishmateriallari", explored clay deposits suitable for the production of expanded clay in our republic: Jizzakh region - 2, Kashkadarya region - 2, Navoi region - 3, Republic of Karakalpakstan - 3, Samarkand region - 1, Surkhandarya region - 1, Tashkent region - 1, Fergana region - 3 [4]. Nevertheless, the number of enterprises for the production of expanded clay in our republic remains limited.

World practice shows that the further development of lightweight concrete construction has shown the advantages of structural expanded clay concrete: it can significantly reduce the consumption of materials, the mass of the building and the price of the foundation, and increase the number of storeys of buildings, while the cost of construction is reduced by 30-40% [5]. In addition, the use of expanded clay concrete in the supporting structures of buildings reduces heat loss through these structures and increases the energy efficiency of the building. Therefore, we believe that the creation of effective structural, heat-insulating and structural expanded clay concrete compositions and technologies for their production based on local raw materials will increase the scale of their use.

The purpose of our scientific research is to study the properties of expanded clay produced in our republic in order to obtain effective structural expanded clay concrete.

Used materials and research methods

In our scientific study, the physical and mechanical properties of expanded clay aggregate produced in different regions of our republic were studied. These are Navoi Expanded Clay LLC, located in the Navoi region, Karshi Keramzit OTAD, located in the Kashkadarya region, Gazalkent Expanded Clay Plant LLC, located in the Tashkent region. The conditional specification of expanded clay used in our research is presented in Table 1.

Table 1. Conditional nomenclature of expanded clay samples

№	The name of the enterprise producing Keramzite	Conditional name
1	"Navoiy Keramzit" LLC	К 1
2	"Opposite Keramzit" OTAJ	К 2
3	"Ghazalkent Keramzite Plant"	К 3

The physical and physico-mechanical properties of the selected samples of expanded clay were determined on the basis of the current regulatory documents [6].

Research results

As a result of visual analysis, expanded clay K-1 has an oblong, cylindrical shape, the outer surface is light reddish-brown (Fig. 1,a), and when fractured, the inner surface is dark gray, light brown and has an almost uniform distribution of pores (Fig. 2,a).

Visual analysis of expanded clay K-2 shows that the grains have an elongated, cylindrical shape, and the outer surface has a uniform brown appearance (Fig. 1,b), it was found that it is almost evenly distributed over the considered surface. (Fig. 2,b).

Fig. 1. Appearance and fractions of selected samples of expanded clay: a - K-1; b - K-2; c - K-3.

Visual analysis of expanded clay K-3 shows that expanded clay grains have an almost rounded shape, the outer surface is reddish-brown in color (Fig. 2, c), and the inner surface is uniform dark gray, the pores were determined to be small and almost evenly distributed (Fig. 3, h - drawing).

Fig. 2. View of macropores of selected expanded clay samples: a - K-1; b - K-2; c - K-3.

In our opinion, the variety of colors of expanded clay grains can be explained primarily by the variety of raw materials used in their production.

K1 - M450, respectively, according to the bulk mass of expanded clay samples; It was established that K2 - M600 and K3 belong to the M700 grades (Table 2). In addition, it was determined that the density of expanded clay grains is 2.388, 2.475 and 2.525 g/cm3 for K1, K2 and K3, respectively, and the average grain density is 654, 832 and 851 kg/m3.

Taking into account that the grades of expanded clay used for expanded clay concrete are in the range of M150-M1000, it can be assumed that the investigated expanded clay samples meet the requirements of GOST for bulk density.

The results of water absorption (Table 3) also fully met the requirements of GOST of our samples.

Taking into account the fact that the grades of bulk and average density are in the range of M150-M1000, it was found that the bulk and average density of the studied expanded clay samples meet the specified requirements.

Table 2. Physical parameters of expanded clay samples

Conventional name of expanded clay samples	Bulk density, kg/m^3 according to GOST 32496-2013	Average density of grains, kg/m^3	Density, g/cm^3	Expanded clay grain porosity, %	Distance between grains, %
K 1	435 / M450	654	2,388	73	33
K 2	590 / M600	832	2,475	66	29
K 3	682 / M700	851	2,525	66	20

Table 3. Water absorption, thermal conductivity coefficient and compressive strength of expanded clay samples

Conventional name of expanded clay samples	Water permeability by weight, % according to GOST 32496-2013	Water absorption by volume, %	Coefficient of thermal conductivity, W/м·К	Cylinder compressive strength, MPa	Strength grade according to GOST 32496-2013
K 1	23,46 / ≤25	15,3	0,197	2,86	П125
K 2	16,9 / ≤25	14,05	0,2744	4,43	П150
K 3	16,8 / ≤20	14,2	0,2825	5,07	П200

Summary

We examined the properties of expanded clay fillers produced in the Republic of Uzbekistan using the above samples as an example. The compressive strength of the samples showed that K-1 - 2.86 MPa (P125), K-2 - 4.43 MPa (P150), K-3 - 5.07 MPa (P200). According to the requirements of GOST 32496-2013, depending on the average density, it is determined that it should be K-1 - M450 (P75), K-2 - M600 (P125), K-3 - M700 (P150). Based on this, it was shown that the compressive strength of expanded clay fillers not only meets the requirements of GOST 32496-2013, but also exceeds the specified strength values.

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