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RESULTS OF EXPERIMENTAL RESEARCH ON OBTAINING LOW- CEMENT WALL MATERIALS FROM WASTE OF SAMING OF LOCAL LIME STONES

UDC – 691.316

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OF LOCAL LIME STONES**

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<https://doi.org/10.56243/18294898-2023.4-20>

Abstract

The results of experimental studies are presented on the production of single low-cement modified dry-pressed bricks from limestone stone sawing waste from Martakert stone quarries. The technological parameters for the manufacture of these bricks and their physical and mechanical properties have been established. A high convergence of the properties of the resulting wall material was determined in comparison with ceramic and silicate bricks used in construction. Using the method of analogy, the compliance of the quality indicators of experimentally obtained bricks with the requirements of regulatory documents was proven.

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The fundamental possibility of producing low- cement bricks from stone sawing waste from local quarries, as well as their use in construction, has been established. The production of low-cement bricks makes it possible to increase construction efficiency and reduce the cost of operating completed facilities. This also leads to a reduction in environmental risks from the accumulation of stone sawing waste in large areas and pollution of the air and water basins of the region.

Keywords: waste limestone, dry pressing, technological parameters, brick, modifier, convergence.

Introduction

In the construction complex of Nagorno-Karabakh, the most common are structural solutions for the walls of buildings made of sawn limestone, dimensions 390x190x188 mm, weighing 30-32 kg. Masonry made from these materials is characterized by high labor intensity, technological imperfections and as a consequence a shortage of specialists.

The problem is also complicated by the variability of the physical and mechanical properties of local limestones, such as: bulk density(1960–2080kgf/m³), water absorption (11.5-14.5%), strength (8.4-13.6MPa), etc. [1,2,3]. The variability of the physical and mechanical properties of limestones lead to a decrease in the quality of masonry, which limits their use for the construction of load-bearing wall structures of multi-story buildings in earthquake-resistant construction. In general, sawn limestone masonry does not correspond to the nature of modern construction, and the transition to light weight concrete small-piece wall materials, taking into account changes in the structural layouts of buildings, leads to an increase in the estimated cost by almost 40%.

An analysis of the costs of using artificial wall materials in construction (ceramic, lightweight concrete, cellular, silicate, etc.) showed that the most economical are stones made from cellular and silicate concrete [4]. However, given the limited energy capabilities, the production of these materials has not received further development. Making masonry from hyper-pressed bricks also does not solve the problem, due to the increase in the estimated cost of construction and the increase in operating costs of the buildings and structures being constructed [5, 6].

The research of the problem [7-11] led to a working hypothesis about the possibility of producing low-cement pressed wall materials from waste stone sawing limestone from local stone quarries. This solution to the problem also has an environmental focus - reducing the risk of waste accumulation over large areas and pollution of the air and water basins of the region.

Conflict Setting

Improving the technical and technological parameters of erected stone structures in earthquake- resistant construction, using wall materials from local limestone sawing waste. The possibility of implementing this idea was confirmed by experimental studies\ of the scientific and production association “SAT” in Yerevan

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Research Results

1. Determination of the chemical and mineralogical composition of the starting materials.
2. Identification of the ratios of the components of the feed stock. Determination of technological parameters for the production of molding sand.
3. Establishing the physical and mechanical properties of the new material, their compliance with the requirements of current regulatory documents for construction.

The following materials were used as starting materials for the experiments:

- Limestone waste from stone sawing of the Martakert stone quarry;
- Portland cement grade 400 from Ararat Production Association “Ararat Cement”;
- Natural pigment from the Hrazdan deposit;
- plasticizer, water-soluble methyl cellulose MC-100(TC6-05-1857-78).

Experimental studies have determined the technological parameters for the production of single bricks (250x120x65mm), dry pressing from a modified molding mixture and their physical and mechanical properties (tab. 1).

Table 1

Compositions and technological parameters for the production of cement-limestone mixtures and their physical and mechanical properties

Ingredients №	Technological properties							Physical and mechanical properties		
	Waste, g.	Portlan cement, g.	Pigm ent, g.	Modifi er, %	Water, g.	Stirrin g time, min	Molding time, min	Pressing force, MPa	Water absorption, %	Density, g/cm ³
1	2	3	4	5				6	7	8
1	4000	160			520	9	10		13,5	2,018
2	4000	200			520	4,9	2		13	1,944
3	4000	240			240	4,8	1	3,5	14,7	2,013
4	4000	320			400	5,3	1.3		14,9	1,995
5	4000	320			520	4,8	2.8	6,3	12,1	2,06
6	4000	400			600	4,0	1.4	8,1	10,8	2,13
7	4000	500			400	3,2	1.2	8,9	10,4	1,985
8	4000	240	120		240	4,7	1.9	5,4	14	2,02
9	4000	240	200		320	3,2	1.3	6,0	13,6	2,00
10	4000	240	200		400	2,8	1.1	6,4	12,5	2,05
11	3599	240		3,3	240	-	0,75	14,0	6,1	1,992

The molding of the mixture was carried out under a pressure of 80 MPa , because The pressing force on a single brick, according to various sources, should not exceed 300 kg/cm². Experimental studies of the possibility of manufacturing wall materials were carried out using dry (samples 3, 8, 9, 11) and semi-dry pressing methods (samples 1, 2, 4, 5, 6, 7, 10). Sample 11 was made with the introduction of modifier MC-100 (TC6-05-1857-78) Into the composition of the molded mixture in an amount of 3.3% (tab. 1).

Frost resistance tests of samples 7 and 11 were carried out at the scientific and production association “SAT” (tab. 2), control testing of their strength was carried out in the

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central testing laboratory, Natural porous aggregates of volcanogenic rocks of the Republic of Armenia for concrete. (tab. 3).

Analysis of the convergence of physical and mechanical properties of low-cement single dry- pressed bricks, in comparison with ceramic and sand-limebricks (tab. 4).

Table 2

Results of testing samples for frost resistance

Mixture ingredients	Control strength of samples, MPa	Strength of samples after testing them for Frost resistance, MPa	Strength loss, % after frost resistance Testing at 25 cycles
N7	3,5	3,05	12.85
№11	14,0	13,5	3.50

Table 3

Results of control tests for pressing strength of samples

№	Sample number	Weight, g	Product volume	Compression strength, kg/cm ²	
				Sample strength	Average value
1	7	3900	12x12	34*	67
2		4215	12.1x12	66	
3		4450	12x12	69	
4	11	3385	12.2x12.1	142	142
5		3895	12.1x12.1	143	
6		3645	12.3x12.1	144	

Note34*- random size.

Table 4

№	Brick types	Basic physico-mechanical properties					Notes
		Density g/cm ³	Compressive strength mark, MPa	Water absorption, %	Thermal conductivity, watt/m ² °C	Frost resistance cycles	
1	2	3	4	5	6	7	8
1	Low-cement Dry pressing	1.992	15	6.1	0.5	25	Experimental results
2	Ceramic	1.960	No less 15	No less 6	More 0.5	No less 25	GOST 530-2012
3	Silicate	before 2100	No less 15	6	No less 0.56	No less 25	GOST 379-95
4	Average values	1.985	15	6.03	0.52	25	-
5	Convergence	0.07	0	0.17	0.12	0	-

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The high convergence of the physical and mechanical properties of the experimentally obtained bricks in comparison with the ceramic and silicate bricks used in construction, as well as the analysis of the results by the method of analogy, led to the conclusion that the composition and quality indicators of low-cement modified bricks correspond to the current building standards for construction, including SNRA1V-13.01-96“Stone and reinforced stone structures”.

Conclusion

Based on the results of experimental studies, the fundamental possibility of producing a rational material for laying walls from stone sawing waste from the Martakert limestone quarry was proven, which confirmed the reliability of the working hypothesis.

It has been established that the method of dry pressing of a molding mixture with a cement content of up to 7% and a modifier in an amount of 3.3% makes it possible to obtain wall material with a compressive strength of 142 kg/cm² and a density of 1.992 g/cm³. At the same time, compared those drypressing, cement consumptions reduced by more than two times.

A promising direction of research is the experimental substantiation of the possibility of producing a wider range of building materials from limestone waste (tiles, lined slabs, ventilation blocks, etc.) based on waste-free technology in a closed cycle.

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ՏԵՂԱԿԱՆ ԿՐԱՔԱՐԻ ՔԱՐԱՀԱՆՔԵՐԻ ԹԱՓՈՆՆԵՐԻՑ ՍԱԿԱՎԱՑԵՄԵՆՏԱՅԻՆ ՊԱՏԻ ԼՅՈՒԹԵՐ ՍՏԱՆԱԼՈՒ ՓՈՐՁԱՐԱՐԱԿԱՆ ՀԵՏԱՂՈՏՈՒԹՅԱՆ ԱՐԴՅՈՒՆՔՆԵՐԸ

Իսրայելյան Ռ.Գ., Մարգարյան Ա.Յա., Իսրայելյան Մ.Ա., Գրիգորյան Ա.Ա.

Շուշիի տեխնոլոգիական համալսարան

Ներկայացված է տեղական կրաքարի քարահանքերի թափոններից միատարր սակացեմնտային չոր մամլումով արտադրության փորձարարական ուսումնասիրությունների արդյունքները: Սահմանվել են նշված աղյուսների արտադրության տեխնոլոգիական պարամետրերը և ֆիզիկո-մեխանիկական հատկությունները: Որոշվել է ստացված աղյուսների հատկությունների բարձր համընկնումը շինարարությունում օգտագործվող կերամիկական և սիլիկատային աղյուսների հետ: Նմանակությունների մեթոդով ապացուցվել է փորձնականորեն պատրաստված աղյուսների որակի ցուցանիշների համապատասխանությունը նորմատիվային փաստաթղթերի պահանջներին: Սահմանվել է տեղական կրաքարերի թափոններից պատրաստված սակացեմնտային աղյուսների օգտագործմանը շինարարությունում: Սակացեմնտային աղյուսների արտադրությունը թույլ է տալիս բարձրացնել շինարարության արդյունավետությունը և նվազեցնել շահագործվող օբյեկտների գործնական ծախսերը: Սա նաև հանգեցնում է շրջակա միջավայրի ռիսկերի նվազմանը, որոնք կապված են մեծ տարածքներում թափոնների կուտակման հետ, ինչը հանգեցնում է տարածաշրջանի օդի և ջրի աղտոտմանը:

Բանալի բառեր. կրաքարի թափոններ, չոր մամլում, տեխնոլոգիական, պարամետրեր, աղյուս, վերափոխիչ:

РЕЗУЛЬТАТЫ ЭКСПЕРИМЕНТАЛЬНЫХ ИССЛЕДОВАНИЙ ПО ПОЛУЧЕНИЮ МАЛОЦЕМЕНТНЫХ СТЕНОВЫХ МАТЕРИАЛОВ ИЗ ОТХОДОВ КАМНЕПЕЛЕНИЯ МЕСТНЫХ ИЗВЕСТНЯКОВ

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Приводятся результаты экспериментальных исследований по изготовлению одинарных малоцементных модифицированных кирпичей сухого прессования из известняковых отходов камнепеления Мартакертских каменных карьеров. Установлены технологические параметры изготовления этих кирпичей и их физико-механические свойства. Определена высокая сходимость свойств полученного стенового материала, в сравнении с используемыми в строительстве керамическими и силикатными кирпичами. Методом аналогии доказано соответствие показателей качества экспериментально полученных кирпичей требованиям нормативных документов. Установлена принципиальная возможность изготовления малоцементных

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кирпичей из отходов камнепиления местных карьеров, а также их применения в строительстве. Производство малоцементных кирпичей позволяет повысить эффективность строительства и снизить затраты на эксплуатацию завершенных объектов. Это приводит так же к снижению экологических рисков от накопления отходов камнепиления на больших территориях, и загрязнения воздушных и водных бассейнов региона.

Ключевые слова: отходы известнякового камня, сухое прессование, технологические параметры, кирпич, модификатор.

Submitted on 16.10.2023

Sent for review on 18.09.2023

Guaranteed for printing on 25.12.2023