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Efficiency Of Low-Water-Requiring Cements And Concrete Mixtures And Concretes Based On Them With Basalt (Slag) Aggregate

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Efficiency of Low-Water-Requiring Cements and Concrete Mixtures and Concretes Based on Them With Basalt (Slag) Aggregate

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Abstract: The shortage of material and energy resources in the world requires the effective use of local raw materials and industrial waste in the building materials industry. In developed countries, it is important to increase the volume of cement production, use industrial waste in production, reduce the cost of cement by reducing the amount of clinker in its composition without reducing the quality of cement, and increase its efficiency. In particular, as a result of the increased demand for cement, special attention is paid to the development of energy-efficient production technologies using existing local raw materials and industrial waste.

INTRODUCTION

When applied, building materials, objects and structures must withstand external forces and environmental influences. Therefore, the building material used in the preparation of items, materials must be resistant to physical and chemical, mechanical influences, vapor in the air, gas exposure, temperature changes, humidity, water Frost exposure when repeatedly frozen and melted. To develop the production of building materials, we have a large supply of raw materials. The abundance of fossil resources and raw material products (oil and gas production, precious stones, iron ores, limestone, gypsum, etc.The abundance of fossil resources and raw material products (oil and gas production, precious stones, iron ores, limestone, gypsum, etc.k.) Opens up wide opportunities for the development of the production of building materials. At the same time, the widespread use of industrial waste in the production of building materials is also one of its main tasks. For example, from slags with industrial waste of metallurgy, various dense, porous and fibrous-structured objects are obtained in the construction materials industry. The use of industrial waste, along with the expansion of the raw material base for building materials, also provides the opportunity to free up most of the land occupied by waste, to clean the environment. One of the main tasks in the development of the production of building materials is to make more use of domestic raw materials and increase the quality of products derived from it. For example, basalt slag, which is a local raw material, gives the economic effect of obtaining solid heavy concrete, based on Lime and sand.

In our republic, further deepening economic reforms in the building materials industry, improving and developing production, their economic efficiency at the modern stage, the production of energy-efficient low-water demanding Cements with a high-quality recognition price of complex and rational use of domestic raw materials and industrial waste sources, as well as obtaining concretions based on them are urgent problems.

The decree of the president of the Republic of Uzbekistan dated July 6, 2022 PQ-307 “on organizational measures for the implementation of the innovation development strategy of the Republic of Uzbekistan in 2022-2026”, PF-158 of September 11, 2023 “on the effective use of the local raw materials base and the development of an industry based on advanced technologies”, “on the radical improvement of environmental problems affecting human life in the Republic”, it also serves to carry out research work in the implementation of the tasks set out in all regulatory legal acts related to this activity

RESEARCH OBJECT AND MATERIAL

- As the main object of the study, low-water demanding cements developed on the basis of basalt (shlaki) rock, physical and mechanical and exploratory properties of concrete mixtures and ready-made concrete samples were obtained from them.
- The following raw materials and components were used in the production process:
- * Basalt (shlaki) rock — derived from local sources, the average particle size is 0.5–5 mm. the main object of the study, low-water demanding cements developed on the basis of basalt (shlaki) rock, physical and mechanical and exploratory properties of concrete mixtures and ready-made concrete samples were obtained from them.
- The following raw materials and components were used in the production process:
- * Basalt (shlaki) rock — derived from local sources, the average particle size is 0.5–5 mm.
- • Portlandsement (M500) — according to standard gost 10178-85 [1] requirements.
- * Mineral additives-microsilicate and ash (fly ash), in a ratio of 5-15%.
- • Water-clean drinking water according to technical requirements.
- • Chemical additives-superplastifiers (based on polycarboxylate) to reduce the water-cement ratio.

LITERATURE REVIEW AND METHODS

The study was carried out at the following stages:

1. Sample preparation

• Cement mixtures and concrete mixtures were prepared at a water-cement ratio (w/c) of 0.25–0.40 intervals.

• The mixtures were prepared in a concrete mixer (with a capacity of 20 l) according to the 3-stage mixing technology: mixing dry components, adding water and additives, final homogenization.The study was carried out at the following stages:

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2. Laboratory tests

* Determination of crustal performance-Abram cone deposition method (GOST 10181-2014) [2].

* Compression and hardening dynamics - using Vicat pribori (GOST 310.3-76)[3].

* Concrete density-according to GOST 12730.1-78[4].

• Compressive strength-determination according to GOST 10180-2012 in samples hardened for 7, 14 and 28 days.

• Water permeability coefficient-according to GOST 12730.5-84[5].Concrete density-according to GOST 12730.1-78[4].

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• Freezing-using freezing / thawing cycles (GOST 10060.0-95)[6].

3. Efficiency assessment criteria

• The level of attainment of performance determined by the minimum water consumption.

• Increase in compression strength (%) for 28 days.

* Improved density and waterproofing indicators.

• Increase in frost resistance indicators (number of cycles).

4. Data processing

The experimental data obtained was processed statistically, calculating the average arithmetic values, dispersion and standard deviations. Microsoft Excel and OriginPro applications were used for analysis. The results were presented in the form of tables and graphs, efficiency indicators were compared with theoretical models.

This study was carried out within the framework of the priority “effective use of the local raw material base and development of an industry based on advanced technologies”, which is listed in the annex of Decree No. 158 of the president of the Republic of Uzbekistan on the strategy of Uzbekistan-2030 (adopted on September 11, 2023).

Major researchers around the world with problems of creating and using local raw materials and industrial waste, mineral Binder and producing high-quality concretions using them, developing their compositions, improving

physical and mechanical and technical characteristics and increasing their strength, including: Volzhensky A. V..[7], Pashyenko V.[7], Pashyenk V.[7], Pashyenko A.A.[8],Timashev V.V., Schmidt M.[9], Zhao Qinglin, Chen.[7], Pashyenko A[7], PashyenkoV.[7], Pashyeko A.A.[8],T[7], Pashyenko AV.[7], PashV.[7], PashyenV.[7], Pashyenko A.A.[8],T[7], PashyesV.[7], Pashyenko A.A.[8],Timashev V.V., Schmidt M.[9], Zhao Qinglin, Cheng Xin, Stark J., Wicht B., Batrakovted significantly to the resolution of these issues.

Scientists of our country have conducted a number of studies in the study of the development of the composition of building materials on the basis of domestic homashyo and industrial waste, improving the structure and properties and improving their effectiveness. Odilkhaojayev A.ScScientists of our coScientists oScientists of ouscientists of ourScientistsssScientists of oScientists ofsScientists of our scientists of our country have conducted a number of studies in the study of the development of the composhieved significant results in this area based on their research in different years.

Analysis of the research carried out showed that significant positive results were obtained in the field of improving the production of low-water demanding Cements and creating resource-efficient technologies. However, the fact that there is insufficient research in our Republic aimed at developing effective compositions of low-water demanding cements suggests that it requires more extensive research work in the Soha.

The local raw material consists of optimizing high-quality low-water demanding cement compositions using technogenic waste (basalt shale) while saving the amount of cement clinker and their application in the production of the underlying concretions.

The object of the study was obtained low-water demanding Cements and concretions using cement clinker,basalt slag, Barkhan sand and superplastifier JK-02.

The subject of the study is the physical-chemical, physical-mechanical and technical-economic parameters of low-water demanding Cements and the concretions on which they are based, using man-made waste and local raw materials.

In cement production, the forming components in roller and gear zm-800 mills are a scientifically based solution to improve the physical and mechanical properties of Cements and concretes obtained by joint grinding, that is, mechanical activation and modification. According to the results of this scientific research work, the determination of the specified properties of Cements and concretions depends on the physicochemical target effect on cement, which is indicated by the exact formation.

RESULTS

Low water is of the type of cements obtained using such a method of mechanical activation and modernization of the components that make up in the production of demanding Cements, and in their preparation it is necessary to take into account the type and properties of chemically active mineral additives used for modification.

The effect of a comparable Surface Surface on the normal thickness and hardening time of cement is shown in Table 1.

TABLE 1. Composition and properties of PS-500 and low-water demanding cements

T/r	PS clinker quantity, %	Gypsum stone, %	Basalt slake, %	Barkhan sand	JK-02 amount, %	Specific surface area, m2/kg	Water-cement ratio, %	Strength, MPa	
								3 days	28 days
1	95	5	0	0	0	320	25,6	15	51.9
2	65	5	15	15	0.6	500	17.0	29	68.7
3	55	5	15	15	0.8	550	18.0	26	59.2
4	45	5	15	15	1	570	19,0	19	50.8

The mill showed a high strength when the strength of the 3-day Strength of the crushed cement to 550 m2/kg softness was compared to the contrast sample, i.e. a simple portlandsement sample that was not mechanoactivated,

and can be seen to be 19 MPa, 26 MPa, 29 MPa respectively. This can be explained by the fact that the results depend on the degree of softness of the cement and the amount of active mineral particles in the cement.

TABLE 2. Qizilqumsement SEM I 42.5 and the amount and description of raw materials that make up low water demanding cement

№	Cement name	PS clinker, %	Basalt slake, %		Ash, %	Barkhan sand, %	Super. JK-02, %	Hypostasis, %	Comparison surface area, m2/kg	Normal thickness, %	strength	
											Given hot-wet processing, MPa	28 days, MPa
1	SEM I 42.5	95	-		-	-	0.8	5	450	25.1	48.3	51.1
2	KSTS-50	50	15		15	15	0.6	4.4	578	17.8	50.8	52.3
3	KSTS-50	50	15		15	15	0.8	4.2	580	18.1	52.2	55.5
4	KSTS-50	50	15		15	15	1.0	4.0	579	17.3	51.9	53.8
5	KSTS-55	55	10		15	15	0.6	4.4	581	17.9	55.8	59.9
6	KSTS-55	55	15		10	15	0.8	4.2	580	17.9	59.2	63.5
7	KSTS-55	55	15		15	10	1.0	4.0	579	17.6	60.1	61.8
8	KSTS-60	60	5		15	15	0.6	4.4	580	18.6	60.2	63.3
9	KSTS-60	60	15		15	5	0.8	4.2	585	17.0	63.8	65.9
10	KSTS-60	60	15		5	15	1.0	4.0	587	17.3	62.1	64.5
11	KSTS-65	65	5		10	15	0.6	4.4	589	17.5	65.8	67.6
12	KSTS-65	65	15		10	5	0.8	4.2	590	17.9	67.4	70.1
13	KSTS-65	65	15		10	5	1.0	4.0	587	19.0	69.0	71.4
14	KSTS-70	70	5		15	5	0.6	4.4	595	17.4	70.2	73.9
15	KSTS-70	70	10		10	5	0.8	4.2	600	18.8	74.0	78.8
16	KSTS-70	70	15		5	5	1.0	4.0	597	19.0	71.1	75.2

Low water has been studied for the strength of the demanding cement stone in natural conditions and in compositions given hot wet treatment.

TABLE 3. Optimal compositions of heavy concrete.

T/r	Cement type	Material consumption, (kg/m3)				Plasticizer JK-02	S/S	Mobility brand	Mixture density (kg/m3)
		Cement	sand	Flint	water				
1	SEM I 42.5 N	400	687	1202	175	-	0.44	P5	2464
2	KSTS-50	400	725	1225	135		0.34	P3	2485
3	SEM I 42.5 N JK-0.8%	400	712	1207	160	0.8	0.40	P4	2479
4	KSTS-50	400	703	1254	130		0.33	P3	2487

The scientific study carried out from the results of the experiment shows from Table 3 that in terms of the technological properties of a heavy concrete mixture of equal Mobility, s/S=0.26, the mixture was found to be effective (T/r No. 4) with a density of 2507 kg/m3.

TABLE 4. Strength of concrete number 1-4 based on Table 3.

T/r	Cement type	Concrete strength $R_{squeeze}$, (kgs/sm^2)			Clinker consumption, 1m^3, S_{kg}	Comparative robustness $R_{casting}$, (kg/sm^2/kg)		
		Concrete hardening period				Concrete hardening period		
		1 day	Heat treatment	28 days		1 day	Heat treatment	28 days
1	SEM I 42.5	145	492	530	420	0.35	1.17	1.26
2	KSTS-50	187	502	576	210	0.89	2.88	3.11
3	SEM I 42.5, JK-02-0.8%	195	498	545	420	0.46	1.46	1.66
4	KSTS-50	218	505	555	231	0.94	2.96	3.0

When the properties of heavy concrete based on low-water demanding cements of basalt scale (rock)are analyzed, the decrease in water demand due to the reduction of contact points between the grains of different basalt scale (rock)with a high concentration of basalt scale (rock) indicates a certain amount of strength.

The composition and properties of the concrete mixture based on SEM I 42.5 and low water demanding Cements are presented in Table 5.

TABLE 5. Experimental test results

T/r	Cement	Material consumption, kg/m^3				$K_{dipping}$, sm	S/S	Density, kg/m^3
		Cement consumption	fillers		water			
			sand	Flint				
1	SEM I 42.5+SP JK-02	420	795	1100	175	10	0.42	2490
2	KSTS-50	420	755	1200	130	9	0,31	2505
3	KSTS-55	420	775	1200	128	9	0,30	2523
4	KSTS-60	460	764	1200	138	9	0,30	2562
5	KSTS-65	480	768	1200	133	7	0.29	2581
6	KSTS-70	480	772	1200	133	7	0.29	2585

Table 5 shows that “Qizilqumsement” SEM I 42.5, superplastifier JK-02 – 0.8%, low water-demanding cement-based heavy concrete samples of basalt scale (gravel)showed high strength of hardened concretes from heat treatment under normal conditions or.able 5 shows that “Qizilqumsement” SEM I 42.5, superplastifier JK-02 – 0.8%, low water-demanding cement-based heavy concrete samples of basalt scale (gravel)showed high strength of hardened concretes from heat treatment under normal conditions or. The main reasons for this are due to the high degree of softness of the cement, the presence of a basalt scale (masonry)-10%, a superplastifier-0.8%, active and chemical additives in the composition, the formation of a high-strength structure under their influence. That is, the S / S ratio is small, the mobility of the concrete mixture (K-immersion) is equal, has a positive effect on the high density.

CONCLUSIONS

1. Crushed basalt slag has a high dispersion and is considered an effective mineral waste, due to its vitreous structure and high specific surface area, it was found in literature analysis that low water is an active mineral additive in demanding cement-based systems.

2.. Crushed basalt slag has a high dispersion and is considered an effective mineral waste, due to its vitreous structure and high specific surface area, it was found in literature analysis that low water is an active mineral additive in demanding cement-based systems.

2. In studies on low-water demanding cements, it was found that the crystallization process and the factors that create the curing system are desirable as an addition to the softness of the cement, the high strength of the cement stone formed

3. Using modern methods of physical and chemical and physical and mechanical research, the properties of raw materials and components used in research work were studied and carried out using modern research methods of physical and chemical and physical and mechanical research, and scientific analysis was carried out.

4. Optimal parameters of low water demanding Cements with a specific surface surface area of 550-600 m2/kg “cement clinker, basalt scale (gravel), ash, Barkhan sand, superplastifier in a five-System System, a mathematical demanding regression of the selection of logical and structural quantities of raw materials for low water cement with basalt scale (Gravel)has been developed.

5. Using the method of mathematical planning of carried out scientific research experiments, a mathematical regression on the optimization of low – water demanding cement compositions obtained by mechanical activation of components with an optimal parameter of 65-75% cement clinker, basalt scale (gravel) – 15%, Barkhan sand-10%, and the optimization of technological parameters of production according to the results of the analysis.

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