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ARTIFICIAL SiO_2-CONTAINING MINERAL-ACTIVE ADHESIVE MATERIAL AND CONCRETE PURCHASE RESEARCH

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Abstract- The possibility of using waste from aluminum oxide production (APW) of the Ganja production association "Gil-Soil", located on the territory of the Republic of Azerbaijan, as a mineral active additive was experimentally determined. When using the APV additive up to 10% of cement consumption, the flexural strength of cement-sand systems increased by 6.2-6.4 MPa in 28 days, and the compressive strength - by 39.5-41.4 MPa in 28 days. Comparison of the obtained results with parameters without additives showed that the activity of the modified adhesive increases by 3.2% and 4.8% respectively. The use of a modified adhesive material was experimentally studied and the issue of processing heavy concrete and polymer fiber-fiber concrete compositions was considered. The development of modified concrete compositions was carried out using the method of mathematical statistical analysis of experiments, mathematical models of the limiting parameters of concrete compressive strength were created, and the properties of the composition were optimized using short rises (replicas) taking into account influencing factors. Experimental tests were developed for modified $S520$ fiber-reinforced concrete with a compressive strength of 46.51 MPa and HP 777 reinforced polypropylene fiber-reinforced concrete with a compressive strength of 48.49 MPa. The compressive strength of such fiber-reinforced concrete increased by 7.01% and 11.5%, respectively, compared with the same indicator of fiber-reinforced concrete without additives.

Keywords: Superplasticizer, Hyper Plasticizer, Aluminum Oxide Production Waste, Heavy Concrete, Fiber Concrete.

1. INTRODUCTION

Construction materials play a large role in the development of modern science and technology. Studying the properties of construction materials has always been of interest to researchers. A deep and comprehensive study of the properties of materials allows to choose materials efficiently for specific operating conditions, both from a technical and economic point of view. Recently, the demand for cement-based concrete with a complex multi-component modifier that can meet the requirements of modern construction has increased sharply. The emergence of new technical and constructive decisions in the tradition of using high-strength concrete is related to increasing the reliability, longevity and efficiency of construction. Including complex modifiers, it has become a powerful tool as a regulator and controller of the properties of monolithic concrete.

Adding various modifiers to the composition of cement and concrete compositions is considered an integral element of concrete technology today. This is explained by the fact that with a relatively small amount of cost, the technological properties of the concrete mixture and the construction-technical properties of concrete can be changed dramatically. Portland cement is produced at the expense of large labor and energy costs and using equipment with high depreciation costs, which requires high tightness, and therefore requires economical operation. In this regard, one of the pressing issues remains the saving of Portland cement, which has found a wide range of applications. Savings on Portland cement is carried out in different directions. One of these directions is grinding clinker with various additives during the production process, another is reducing cement consumption through the use of additives in its application, etc. is possible. Conducted scientific research shows that the use of natural and artificial additives when using Portland cement gives effective results, reducing cement consumption is a wider area of research.

2. LITERATURE REVIEW AND PROBLEM STATEMENT

Depending on the characteristics of the waste itself and the furnace facilities, the reasons for wet and dry production methods and possible application methods were studied. Ways to prevent the release of harmful substances such as dioxins into the environment when using waste such as bottle plastic. A rationale has been given for increasing the activity of clinkers and reducing the grinding time of cement when using waste [1]. The role of inert mineral additives in concrete technology has been studied.

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It was determined that it is appropriate to use inert mineral additives together with superplasticizers to reduce cement consumption [2]. Experimental studies of the influence of micro quartz (pulverized quartz) and blast furnace slag on the water-reducing effect of superplasticizers in self-compacting fine-grained concrete showed that when 30% of cement is replaced with mineral additives, there is a significant decrease in the effectiveness of water-reducing additives. It has been established that, despite a significant decrease in the efficiency of superplasticizers in compositions with mineral additives, it remains quite high - in most compositions the water-reducing effect does not fall below 35% [3].

In the research work, exit ways were investigated in connection with the high price and lack of cement in the construction market of the Russian Federation. Studies have been conducted and the application of organ mineral additives (OMA) has been proposed in order to reduce cement consumption. Experimental planning theory methods were used and compositions of organ mineral additives were prepared taking into account the amount of superplasticizer. It was determined that the use of OMA additive allowed to save $15-30\%$ of cement without losing the strength of concrete [4].

A concrete mixture of 9 ingredients was prepared. Mineral additive was used in amounts of 0%, 2.5%, 5%, 7.5% and 10% of cement weight. It has been determined that an effective result is obtained when using up to 10% of the mineral supplement [5].

A new concrete composition was developed by applying waste from demolished buildings. It has been determined that it is possible to use this type of waste as filler [6]. In the Republic of Azerbaijan, solutions to these problems and the use of new additives in cement systems are being studied. Obtaining high-quality cement stone during the strengthening of deep oil and gas wells is one of the urgent (actual) research areas. To increase the strength of cement, potassium chloride, calcium chloride electrolytes and barite solution were used [7].

Based on the waste of the aluminum industry, an alkaline-mineral adhesive-based composition was developed using physico-chemical methods. It was found that impregnation with hot $CaCl_2$ solution accelerates the drying time. Experiments in the research work were carried out based on mathematical modeling [8]. The effectiveness of the application of concrete reinforced with metal fibers in road construction has been investigated [9].

The study was conducted using local volcanic rocks. The composition was prepared using the volcanic ash of Tovuz track, Jeyranchol and Jaibrayil, and the waste of aluminum oxide production and furnace slag of the Ganja aluminum plant as man-made waste. For comparison, micro silica was also used. The analysis of the obtained results shows that it is possible to use up to 5-15% of the amount of cement of pomegranate ground additives [10]. Compositions of an alkali-mineral binder have been developed based on volcanic rocks located on the territory of Azerbaijan (Tauz rock, volcanic ash from the Jeyranchol and Dzhaibrail) and alumina production waste using Physico-chemical research methods. The hardening processes of alkali-mineral binders and concrete based on them have been studied [11, 12]. A composition of an alkali-mineral binder based on alumina production waste has been developed. It has been established that products made from alkali-mineral binder harden under various conditions. Based on alkaline mineral adhesives the average density of the composition was $1815.9\text{-}2611.2\ \text{kg/m}^3$, the compressive strength limit was $15.73\text{-}26.42$ MPa [13, 14, 15].

3. OBJECTIVES AND TASKS OF THE RESEARCH

In the presented work, the use in cement systems as a mineral-active additive of waste from alumina production (APW) of the Ganja Clay-Torpak Production Association, which is a production waste, was studied, as well as possibility of using modified cement in systems of heavy concrete and fiber-reinforced concrete, for this purpose it was developed new concrete composition.

4. RESEARCH MATERIALS AND METHODS

Cement from the Holcim cement plant (Azerbaijan) (Holcim Expert 42.5 R), sand from the Bakhramtepa deposit, crushed stone from the Gudiyalchay quarry located in the Guba region, and fine sand were used in the research work. In this case, superplasticizer brand $S520$ and hyper plasticizer brand HP777 were used. Chemical composition of APW (in % by weight):

$Fe_2O_3 - 41.02$; $Al_2O_3 - 21.49$; $SiO_2 - 16.23$; Na_2O–4.03; TiO_2–3.74; CaO–1.92; SO_3–0.98; K_2O–0.81 MgO–0.01; P_2O_5–0.01; MnO–0.01; Cl–0.01; YTI

Is 9.62 (denotes the number of volatile components at a temperature of 950 °C), and its mineralogical composition, α is quartz SiO_2 (15%), hematite $Fe_2O_3\,(15\%)$ and feldspar (10%). The results are given in Table 1 and Figure 1.

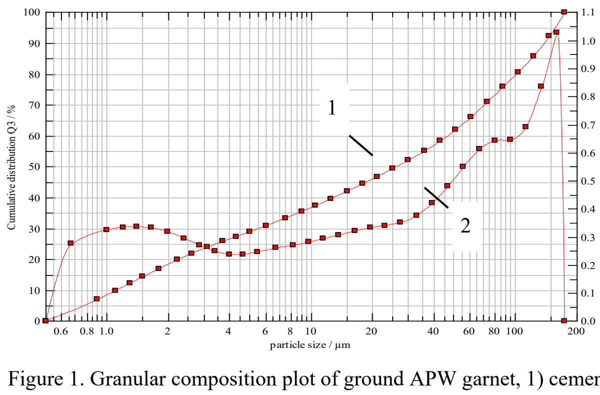

Figure 1. Granular composition plot of ground APW garnet, 1) cement CEM II AL 42.5 R EXPERT, 2) APW

Particle size analysis of the washed APW showed that the test sample was finer compared to the cement. Thus, the number of active grains of crushed APW ultra garnet, the total number of grains less than 8 µm in size, is 34.02%, indicating that the garnet (specific surface area 4887.33 cm^2/g) is larger than the garnet as a whole.

Table 1. Granular composition of ground waste from alumina garnet production

x_0 (μm)	Q_3 (%)	x_0 (μm)	Q_3 (%)
0.90	7.00	15.00	41.96
1.10	9.82	18.00	44.49
1.30	12.24	21.00	46.71
1.50	14.32	25.00	49.28
1.80	16.94	30.00	52.05
2.20	19.70	36.00	55.02
2.60	21.82	43.00	58.26
3.10	23.87	51.00	61.82
3.70	25.77	61.00	66.09
4.30	27.31	73.00	70.86
5.00	28.86	87.00	75.74
6.00	30.80	103.00	80.46
7.50	33.31	123.00	85.78
9.00	35.45	147.00	92.22
10.50	37.32	175.00	100.00
12.50	39.54		

$x_{10} = 1.11$ μm $x_{16} = 1.69$ μm $x_{50} = 26.31$ μm $x_{84} = 116.31$ μm $x_{90} = 138.72$ μm $x_{99} = 171.40$ μm	$SMD = 4.03$ μm $VMD = 49.11$ μm $S_V = 1.49$ m²/cm³ $S_m = 4887.33$ cm²/g

Table 2. The effect of an artificial mineral-active additive containing aluminum oxide production waste on the properties of cement-sand systems

No.	Compo-sition in % by weight: Cement, Cem 42.5	Compo-sition in % by weight: addition	Average density, kg/m³	Test results, Strength indicator, MPa, 7 days: When bending	7 days: In compression	28 days: When bending	28 days: In compression
1	100	0	2,05	4.65	29.7	6.2	39.5
2	95	5	2,08	4.66	30.0	6.23	40.2
3	90	10	2,07	4.68	30.8	6.4	41.4
4	85	15	2,03	4.62	28.7	6.0	39.0
5	80	20	1,95	4.60	28.0	5.9	38.7

In the experiments, the flexural strength of cement stone was determined by the UTCM-0120/E device, and the compressive strength by the UTCM-0121/E device. The composition of concrete prepared using motivated cement was optimized in terms of composition and properties using the method of mathematical and statistical design of $2n$ is type experiments. The mechanical properties of concrete (compressive strength) were determined using a hydraulic press UTEST UTK-4320. The size of the washed APS was determined using a Master sizer 3000 granulometric device. The chemical and mineralogical composition of the Ground pomegranate soil APW was studied using X-ray spectral and X-ray structural analysis at the Analytical Center of the Institute of Geology and Geophysics.

The experiments were carried out in several stages according to plan. At the first stage, the effect of ground pomegranate on cement-sand systems was studied, which was used as a crushed mineral-active additive APW.

The cement-sand mixture is prepared in a ratio of 1:3. The normal consistency and holding time of the prepared solution were determined using a Vika device, and 3 pieces of a bar measuring $40 \times 40 \times 160$ mm were prepared from each composition. The samples were tested after curing using standard methods. The results are given in Table 2 and Figure 2.

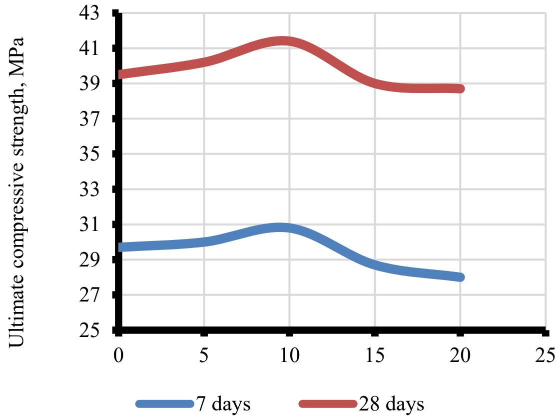

Figure 2. Dependence of the strength of cement stone on the amount of artificial mineral active additive ultra garnet

As can be seen from Table 3 and Figure 2, the 7-day flexural and compressive strengths of cement-sand stone made using APW were higher when 9% cement consumption was used. Thus, the bending strength is after 7 days, 6.2-6.4 MPa after 28 days (3.2%) and compressive strength is 8.0 MPa - 30.8 MPa after 7 days, 39.5 MPa - 41.4. MPa in 28 days (4.8%) increased to.

In the second stage, the modified heavy concrete composition was processed by applying a modified adhesive material. In order to conduct a comparative analysis and select a more effective composition, the composition of heavy concrete based on local raw materials was initially optimized. The selection of the composition of heavy concrete based on local raw materials was carried out using the method of mathematical planning of experiments. At this time, three variable factors were adopted. Cement is X_1, fine aggregate is X_2, coarse aggregate is X_3 were used.

Variable factors and the level of variation were accepted and experiments were carried out using 23 mathematical and statistical designs. Taking into account the requirements of the standard, 3 standard samples of each composition were prepared and recorded. The prepared samples were tested after curing for 28 days. The results of the experiment are shown in Table 3. After the experiments, the results obtained were subjected to statistical analysis using a computer program and regression coefficients were calculated. According to calculations $b_0 = 29.68$; $b_1 = +0.39$; $b_2 = -1.23$; $b_{12} = +0.85$; $b_3 = +0.53$; $b_{13} = -1.7$; $b_{23} = +1.07$; $b_{123} = -0.68$.

According to the statistical analysis, the factors influencing the compressive strength of the resulting concrete are factors X_1, X_2, X_3, X_1X_2, X_1X_3, X_2X_3, $X_1X_2X_3$. Taking this into account, the mathematical model (regression equation) of the compressive strength based on the test results of concrete made from local raw materials is determined as follows:

$$R_{str} = 39.73 + 0.39X_1 - 1.23X_2 + 0.53X_3 + 0.85X_1X_2 - $$
$$-1.7X_1X_3 + 1.07X_2X_3 - 0.68X_1X_2X_3$$

Analysis of the model and regression coefficients shows that due to the increase in the compressive strength of heavy concrete obtained with this composition, it is necessary to partially increase the cement consumption (coefficient X_1) and reduce the amount of fine filler (coefficient X_2) and partially increase the amount of coarse filler (factor X_3). At the same time, the mutual influence of these components on the strength of concrete is obvious. Thus, due to a decrease in the interaction of factors X_1X_3 and $X_1X_2X_3$, an increase in strength is observed. When analyzing the mathematical model, the composition optimization method was chosen using the short lift method (replica).

Table 3. According to the limiting compressive strength parameter of concrete optimization of compositions due to short rise

	Factors influencing by weight, %			Compressive strength, R_{str}, MPa	
	X_1	X_2	X_3	check	valid
0	359	564	1280		
b_i	0.39	-1.23	0.53		
ΔX_i	50	100	100		
$b_i\Delta X_i$	19,5	-123	53		
Round step	+3.9	-24.6	+10.6		
0	359	564	1280	39.73	39.65
1	363	539.4	1290.6	40.02	39.82
2	367	514.8	1301.2	40.53	40.23
3	371	490.2	1311.8	41.60	40.51
4	375	465.6	1322.4	41.90	41.84
5	379	490.2	1333.0	38.61	38.40

As can be seen from the table, as a result of the work done on the mathematical and statistical planning of experiments and the short lifting method, the composition was processed using local materials in kg per 1 m^3 of concrete, the ratio of cement: sand: crushed stone $= 1:1.24:3.53$. According to the experiment, a concrete composition with a compressive strength of 41.84 MPa and an average density of 2293 kg/m^3 was processed.

At the next stage of research, the effect of a mineral component containing ground garnet APW on the properties of heavy concrete was studied. In the experiments, the composition of heavy concrete was developed using materials locally produced in the republic of Azerbaijan. To ensure a comfortable fit of the concrete mixture to the form, a superplasticizer additive of grade $S520$ was also used. To study the interaction of the components used, a mathematical-statistical method of experiment planning was applied and components were optimized. In order to reduce the number of influencing factors (components), the consumption of fillers and water was kept constant according to the initial composition.

Within the framework of influencing factors, an experimental plan was established and the experiments were conducted in laboratory conditions. The mixtures were prepared and the ease of settlement index of the ready-made concrete mixture was determined by means of a truncated cone using a standard method. Then three standard samples of $150\times150\times150$ mm size of each composition were prepared, hardened and tested under normal conditions. The test results were statistically analyzed using a computer program, the regression coefficients were found, and the factors affecting the compressive strength of concrete were determined. According to the test results of concrete prepared with superplasticizer and APW-containing mineral additives, the mathematical model (regression equation) of the compressive strength limit is defined as follows:

$$R^{28}_{(a.sp.s.)} = 41.21 + 0.48X_1 - 1.59X_2 + 0.71X_3 + 1.15X_1X_2 -$$
$$-2.18X_1X_3 + 1.38X_2X_3 - 0.94X_1X_2X_3$$

Three variables were chosen in the experiments. Slightly increasing cement consumption (factor X_1), reducing the addition of APW (factor X_2) and partially increasing the addition of superplasticizer (factor X_3). An increase in the interaction of factors X_1X_2 and X_2X_3 a decrease in the interaction of factors X_1X_3 and $X_1X_2X_3$ increases strength. Taking these conditions into account, the composition of the heavy concrete was optimized by using a short upward path in Table 4.

Table 4. Optimization of the composition of heavy concrete with an artificial mineral-active additive containing waste from alumina production and the addition of superplasticizer $S520$, according to the limiting parameter of compressive strength at a slight rise

	Factors influencing by weight, %			Compressive strength, R_{str}, MPa	
	X_1	X_2	X_3	check	valid
0	359	48.15	5.78	41.21	
b_i	0,48	-1.59	0.71		
ΔX_i	50	24.07	2.41		
$b_i\Delta X_i$	24	-38.27	1.71		
Round step	+1	-1.59	+0.071		
0	359	48.15	5.78	41.21	
1	360	46.56	5.85	42.31	42.05
2	361	44.97	5.92	40.03	40.00

As can be seen from the table, the effective composition of 1 m^3 a mixture of aluminum oxide production waste and new concrete with superplasticizer grade $S520$, composition: cement: APV: sand: crushed stone: superplasticizer = 1 : 0.13 : 1.29 : 3.68 : was the accepted ratio is 0.016. As a result of the experiment, a concrete composition was developed with a compressive strength of 42 MPa and an average density of 2350 kg/m^3. At the third stage, the composition of fiber-reinforced concrete was developed by using various fibers. In the experiments, new concrete compositions were processed using polypropylene fibers of the sika fiber ppm-12 brand, the main performance indicators were studied and the results are shown in Table 5.

Table 5. Physico-mechanical properties of concrete samples reinforced with various fibers

No.	Concrete type	The amount of fiber kg per 1 m³	Physical and mechanical properties			
			Average density, kg/m³		Compressive strength, MPa	
			sample	Average limit	sample	Average limit
1	Heavy concrete	0	2279	2293	39.40	39,60
			2298		39.60	
			2304		39.20	
2	Polypropylene Fiber-reinforced concrete	2	2348	2360	42.89	42.90
			2365		42.94	
			2368		42.87	
		6	2338	2381	43.65	43.53
			2412		43.54	
			2354		43.41	
		8	2368	2370	43.20	43.46
			2370		43.50	
			2373		43.69	
3	Fiber-reinforced concrete with modified adhesive	2	2422	2393	44.90	44.90
			2390		44.81	
			2368		44.99	
		6	2422	2395	45.50	45.09
			2397		44.92	
			2368		44.86	
		8	2396	2400	44.98	45.00
			2400		45.10	
			2406		45.02	

As can be seen from Table 6, the average density and compressive strength of reinforced concrete with polypropylene fiber increased by 3.35% and 9.74%, respectively, compared to heavy concrete. The average density and compressive strength of modified adhesive fiber-reinforced concrete increased by 4.66% and 13.63% compared with heavy concrete, and compared with reinforced concrete with polypropylene fibers increased by 1.26% and 3.54%, respectively.

The results of experiments with fiber-reinforced concrete samples prepared using the addition of a hyper plasticizer, ground garnet APW and polypropylene fiber were carried out using a computer program and fiber-reinforced concrete was obtained with an average test result of $R^{28}_{(k.hp.f.s.)} = 48.49$ MPa. According to statistical analysis indicators $b_1 = -0.061$; $b_2 = +0.306$; regression coefficients were determined equal to $b_{123} = -1.98$ and factors X_2, X_3, X_1X_3, X_2X_3, $X_1X_2X_3$ affecting the compressive strength of concrete. Taking into account the regression coefficients of the influencing factors, a mathematical model of the compressive strength of APW "garnet ground" and polypropylene fiber reinforced concrete with hyper plasticizer additives was developed:

$$R^{28}_{k.hp.f.s.} = 48.49 + 0.306X_2 - 4.91X_3 + 1.57X_1X_3 - $$
$$-2.92X_2X_3 - 1.98X_1X_2X_3$$

Taking into account the signs of the regression coefficients in the resulting model, it can be determined that each of the influencing components used in the preparation of the samples has a different effect on the strength of concrete, both individually and in interaction. Thus, the strength of concrete can be increased within the framework of the influencing factors by increasing the AVT, which is the X_2 component, and reducing the number of polypropylene fibers (many) relative to the average. By increasing the coefficient X_1X_3, which is an indicator of the interaction of components, its interaction has a positive effect on the compressive strength of concrete, and by decreasing the interaction of X_2X_3 and $X_1X_2X_3$ it affects the strength of fiber-reinforced concrete. Taking into account the above, optimization of the composition under study using the method of random replicas (short rise) was carried out according to the following table (Table 6).

Table 6. Optimization of the composition due to a short-term increase in the ultimate compressive strength of fiber-reinforced concrete based on a hyper plasticizer, ultra-fine crushed APW and polypropylene fibers

	Factors influencing by weight, %			Compressive strength, R_{str}, MPa	
	X_1	X_2	X_3	check	valid
0	11	15	18.8		
b_i	-0.061	+0.306	-4.91		
ΔX_i	7	5	6.2		
$b_i \Delta X_i$	-	+1.53	-30.44		
Round step	-	+0.076	-1.52		
0	11	15	18.8	48.49	48.37
1	11	15.076	17.28	41.60	

Taking into account the test results and the levels of variable factors, the limit of compressive strength of fiber concrete with the optimal composition obtained on the basis of hyper plasticizer, APW and polypropylene fibers was 48.49 MPa, and the average density was 2470 kg/m³. According to the results of Table 3, this difference has increased by 15.60%. The mathematical model of the compressive strength limit of S520 superplasticizer, APW and polypropylene fiber-based fiber concrete was obtained as follows:

$$R^{28}_{(k.sp.f.s.)} = 46.10 - 1.555X_1 - 0.949X_2 + 1.5X_1X_2 +$$
$$+2.007X_1X_3 - 0.889X_1X_2X_3$$

Looking at the regression coefficients, reducing the amount of superplasticizer additive (factor X_1), APW additive (factor X_2) and polypropylene fibers (factor X_3) is required to increase the compressive strength limit of the new composite fiber concrete.

Despite the increase of superplasticizer and APW additives (X_1X_2), super plasticizing polypropylene fibers (X_1X_3) in the interaction of new-composite fiber concrete, the reduction of the three-factor interaction ($X_1X_2X_3$) causes an increase in the compressive strength limit of new-composition fiber concrete. Taking into account the influence of changing factors, the composition of the new composition of fiber concrete was optimized by means of a short rise (Table 7).

As can be seen from Table 7, the compressive strength of the test samples based on the concrete mix obtained using pomegranate grinding APW, S520 super plasticizing additive and polypropylene fibers was

46.51 MPa, and the average density was 2450 kg/m^3. According to Table 3, these results are 11.16% higher. In the presented article, the technology of fiber concrete of a special composition was proposed in order to use elements of durable structures.

Table 7. Optimization of the composition of crushed APW garnet, superplasticizer S520 and polypropylene fiber reinforced concrete by slight lifting in accordance with the limiting compressive strength parameter

	Factors influencing by weight, %			Compressive strength, R_{str}, MPa	
	X_1	X_2	X_3	check	valid
0	11	15	18.8		
b_i	-1.555	-0.949	-0.11		
ΔX_i	7	5	6.2		
$b_i \Delta X_i$	-17.105	-14.91	-		
Round step	-1.7	-1.4			
0	11	15	18.8	46.11	
1	9.3	13.6	18.8	46.51	46.44
2	7.6	12.2	18.8	46.11	

All the advantages of this technology, proposed in the tables sequentially listed above (seven tables), have been analyzed and proposed for the production of fiber concrete. The difference between fiber-reinforced concrete elements from conventional ones is that fiber-reinforced concrete structural elements are resistant to tensile deformation and act as a damper during earthquakes [15]. In the article, the seismic resistance of a large-diameter steel fiber reinforced concrete pipe was compared with the strength of a polypropylene fiber reinforced concrete pipe and preference was given to the latter. This comparison was confirmed by experiment. And in the presented article, after adding aluminum oxide powder to polypropylene fiber concrete, the quality of the material increased by 7-11%. The results obtained were proposed for the production of fibro concrete.

5. CONCLUSION

The following results were obtained by studying the effect of aluminosilicate-containing mineral-active additive on cement systems:

1. APW of ganja clay-torpaq production union can be applied as a mineral-active additive.
2. A modified cement composition with the use of 10% APW addition was developed and 4.8% increase in cement activity was determined.
3. Polymer fiber concrete composition with modified adhesive was processed, heavy concrete and fiber concrete compositions were processed with the use of S520 brand superplasticizer and HP777 brand hyper plasticizer, the main physical and mechanical properties were compared with suitable concrete without additives and it was determined that the compressive strength limit of polypropylene fiber concrete is 7.01%, increased by 11.5%. Experimentally, a modified polypropylene fiber concrete composition with a compressive strength limit of 46.5 MPa when using superplasticizer and 48.5 MPa when using hyper plasticizer was developed. It is considered appropriate to use such concrete in road construction.

REFERENCES

[1] O.V. Miroshnikova, I.N. Borisov, "The Use of Various Types of Combustible Waste in Cement Production", Bulletin of BSTU Named After V.G. Shukhov, pp. 71-76, 2018.
[2] M.O. Korovkin, D.M.Grintsov, N.A. Eroshkina, "Rational use of Inert Mineral Additives in Concrete Technology", Engineering Bulletin of the Don, No. 3, Vol. 46, pp. 1-6, 2017.
[3] M.O. Korovkin, N.A. Eroshkina, A.A. Korotkova, "The Influence of Mineral Additives on the Effectiveness of Superplasticizers in Self-Compacting Fine-Grained Concrete Mixtures", Engineering and Construction Bulletin of the Caspian Region, No. 3, Vol. 41, pp. 56-61, 2022.
[4] E.A. Shlyakhova, A.A. Rudenko. "Use of Organ Mineral Additives to Save Cement", Don State Technical University, Rostov-on-Don. Engineering Bulletin of the Don, No. 4, pp. 1-6, 2017, ivdon.ru/ru/magazine/archive/n4y2017/4536.
[5] D. Nagrockiene, G. Girskas, G. Skripkiunas, "Properties of Concrete Modified with Mineral Additives", Construction and Building Materials, pp. 37-42, 15 March 2017.
[6] K. Kishore, N. Gupta, "Application of Domestic and Industrial Waste Materials in Concrete: A Review", Materials Today, Vol. 26, Part 2, pp. 2926-2931, 2020.
[7] A.A. Guvalov, E.K. Shakhbazov, E.A. Guvalov Kazimov, N.Z. Akhmedli, "Development and Research of the Composition of Nano Cement", Scientific Works, No. 2, pp. 62-68, 2020.
[8] T.A. Akhverdieva, "Process of Strengthening and Structuration of Volcano Ashes, Liquid Glass, Sodium Hydroxide, Clay, Postplacement Mixture", International Journal of Academic Research, No. 1, pp. 61-64, 2020.
[9] I.N. Shirinzade, N. Ahmadov, "Development of Effective Fiber-Reinforced Concrete Compositions Used in Transportation Structures", Eastern-European Journal of Enterprise Technologies, pp. 6-11, 2021, researchgate.net/publication/351401760_Development_of_effective_fiberreinforced_concrete_compositions_used_in_transportation_structures.
[10] T.A. Hagverdiyeva, R. Jafarov. "Impact of Fine Ground Mineral Additives on Properties of Concrete", Waste in Production of Building Materials, pp. 73-75, 2019, https://cyberleninka.ru/article/n/impact-of-fine-ground-mineral-additives-on-properties-of-concrete.
[11] T.A. Akhverdieva, "Interaction of the Tauz Trace Rock with Liquid Glass (Sodium Metasilicate)", Journal - Graduate Student and Applicant, Publisher: Society with Online Limitation Publishing House Sput., No. 5, pp. 144-145, 2008.
[12] T.A. Akhverdieva, "Study of the Processes of Hardening and Structure Formation of Alkali-Mineral Binders and Concrete", Journal of Natural and Technical Sciences, No. 1, pp. 369-377, 2010.
[13] T.A. Akhverdieva, "Alkali-Mineral Binders and Concretes Based on Alumina Production Waste", Current Problems of Modern Science, pp. 218-223, 2019.

[14] R.A. Iskanderov, J.M. Tabatabaei, "Vibrations of Fluid-Filled Inhomogeneous Cylindrical Shells Strengthened with Lateral Ribs", International Journal on Technical and Physical Problems of Engineering (IJTPE), Issue 42, Vol. 12, No. 1, pp. 121-125, March 2020.
[15] N.S. Mastanzade, T.M. Rustamli, "Influence of Ground Conditions on Mechanical Characteristics of Fiber-Concrete Sewer Pipes", International Journal on Technical and Physical Problems of Engineering (IJTPE), Issue 58, Vol. 16, No. 1, pp. 80-85, March 2024.

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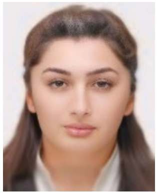

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