Crossref
DOI: 10.31643/2023/6445.34
Engineering and technology

Effect of a complex modified additive based on post-alcohol bard on the strength behavior of concrete

[1]Altynbekova A.D., [1]Lukpanov R.E., [1] Dyussembinov D.S., [1]Askerbekova A.M., [2]Gunasekaran Murali

[1] *L.N. Gumilyov Eurasian National University, Astana, Kazakhstan*
[2] *Division of Research & Innovation, Uttaranchal University, Dehradun 248007, India*

**Corresponding author email: kleo-14@mail.ru*

Received: *September 13, 2022*
Peer-reviewed: *November 14, 2022*
Accepted: *January 30, 2023*

ABSTRACT

The article presents the third stage of the study results of a complex modified additive (CMA), in the accuracy of the influence of the variable ingredients of CMA on the strength of cement. This article shows the methodology of making samples, the selection of additive composition at different percentages of components, and the analysis of the strength behavior of the obtained results. To evaluate the changes in strength, samples were made and tested in compression and bending at 7, 14, and 28 days of normal-moist hardening. The results of the experiment showed that the addition of plasticizers (PAB) reduces the quantity of water - 35%, by increasing the strength of concrete by 20%. Compressive and bending strength results of the modified samples showed the best results, which were in the range of 42.80-63.66 MPa and 3.34-8.75 MPa, compared with the control composition. From the results of the research, the additive accelerates hardening and it was found that the additive contributes to the growth of strength, both at an early age and at the design age (28 days). The results of the experiment showed that from the standpoint of improving the qualitative characteristics of the samples, the use of plasticizers is appropriate. The use of CMA in the composition of concrete increases the strength, and therefore developed by the authors of CMA changes the structure of concrete and most importantly, increases the physical and mechanical characteristics of concrete.

Keywords: concrete, cement-sand mortar, complex modified additive, post-alcohol bard, plasticizer, hardening accelerator, bending strength, compressive strength.

	Information about authors:
Altynbekova Aliya Doszhankyzy	*Ph.D student, Department of Technology of Industrial and Civil Construction, L.N. Gumilyov Eurasian National University, 010000, st. Satbaeva 2, Astana, Kazakhstan. Email: kleo-14@mail.ru*
Lukpanov Rauan Ermagambetovich	*PhD, Professor of the Department of Technology of Industrial and Civil Construction, L.N. Gumilyov Eurasian National University, 010000, st. Satbaeva 2, Astana, Kazakhstan. Email: rauan_82@mail.ru*
Dyussembinov Duman Serikovich	*C.t.s., Assistant Professor of the Department of Technology of Industrial and Civil Construction, L.N. Gumilyov Eurasian National University, 010000, st. Satbaeva 2, Astana, Kazakhstan. Email: dusembinov@mail.ru*
Askerbekova Arailym Myrzakhankyzy	*PhD. Student, Department of Technology of Industrial and Civil Construction, L.N. Gumilyov Eurasian National University, 010000, st. Satbaeva 2, Astana, Kazakhstan. Email: aria_09.91@mail.ru*
Gunasekaran Murali	*Professor of Division of Research & Innovation, Uttaranchal University, Dehradun 248007, India. E-mail: murali_220984@yahoo.co.in*

Introduction

The main objectives of modern construction are to reduce the time required for the manufacture of concrete and reinforced concrete products and accelerate the set of s tandard concrete strengths [1]. Several articles [[2], [3], [4], [5]] discuss these problems in detail and analyze current solutions.

Nevertheless, the task of accelerating the set of standard strength of concrete and preserving its high-strength properties is relevant [6].

The basis of modern concrete technology is the creation of high-quality artificial stone, characterized by high dispersion, a small imperfection, and structural stability. Improving the quality of concrete compositions can be achieved both through the use of chemical additives and by using local components to create a new generation of concrete, which is a very urgent task of concrete technology. New generation concrete is a high-tech, high-quality, multicomponent concrete mixes and compositions with additives that retain the required properties during operation in any conditions. The growth of multicomponent concretes is due to significant systemic effects that allow controlling the formation of the structure at all stages of the technology, ensuring the production of composites of «directional» quality, composition, structure and properties [[7], [8], [9], [10], [11], [12], [13]].

Concrete hardening can be intensified using several methods, including effective complex chemical additives [[14], [15]]. Of practical concern are multifunctional additives that act as effective plasticizers of concrete mixtures and increase the strength of concrete in the early stages of hardening [[16], [17], [18]].

Post-alcohol bard (PAB) - additives are the cheapest, suitable for all types of cement, for monolithic and precast construction from mortar and concrete, for heavy and lightweight concrete, and reinforced concrete, while increasing: strength, density, frost resistance, water resistance, durability, protection against corrosion, and improve the environment.

The aim of the research is to develop a CMA and study its influence on the physical and mechanical characteristics of cement structures. During the research a complex of laboratory tests to evaluate the physical and mechanical characteristics of samples with subsequent comparative analysis of changes in the qualitative characteristics of cement and the influence of a modifier on it has been carried out. This article provides part of the research results (third stage), on the accuracy of determining the influence of a varying mixture of CMA on the strength.

In order to achieve this goal, the following tasks were accomplished:

1. Selection of additive composition at different % ratios of its ingredients;
2. Laboratory preparation of samples of different combinations of additive components;
3. Laboratory studies of strength behavior of test samples;
4. Analysis of the obtained results.

Experimental technique

For the study were used materials that comply with the requirements and standards.

Cement. The raw materials were taken in accordance with the geographical location of the producers, and quality indicators of the material. Portland cement M400 type CEM I 42,5 H was accepted by «Kokshe-Cement» products, due to the availability of this binder.

Fine aggregate. As the fine aggregate used standard polyfractional sand (for the purity of the experiment) corresponding to the requirements of GOST 6139-2003 «Sand for testing of cement».

Modifying additive. Post-alcohol bard - PAB (main component) - ethanol production waste, meets the requirements of Technical Specifications 1110 RK 00393896-01-2003, in quantities of 2.5%, 5.0%, 7.5%, 10%, multiple of 2.5%. The product is supplied in liquid form, producer - JSC «Aydabulsky distillery». Hardening accelerant - gypsum, accelerating the process of hardening, in quantities of 1%, 1.5%, 2.0% and 2.5%, multiple of 0.5%.

The methodology of the experimental work consisted in carrying out several successive operations to create compositions, prepare mixtures, molding standard (40x40x160 mm) beam samples, and test the obtained samples on special equipment, data processing, and analysis. In the third stage, the individual influence of CMA on the strength of cement stone was studied. Compressive and bending strength was determined following GOST 30744-2001 «Cements. Test methods with polyfractional sand» at the age of 7, 14, and 28 days on the equipment Press Automatic Pilot, the total compressive load of 500 kN (50 tons). Material consumption of samples (necessary for measuring the compressive and bending strength) of cement mortar is given in Table 1.

Table 1 – Composition of samples

Number	Type	Cement, g	Sand, g	Gypsum, g	PAB, g	Caustic soda, g	Water, g
1	Type 1 Reference sample	450	1350	-	-	-	180
2	Type 2-1	445.5	1350	4.5	11.25	0.5625	168.1875
3	Type 2-2	445.5	1350	4.5	22.5	1.125	156.375
4	Type 2-3	445.5	1350	4.5	33.75	1.6875	144.5625
5	Type 2-4	445.5	1350	4.5	45	2.25	132.75
6	Type 3-1	443.25	1350	6.75	11.25	0.5625	168.1875
7	Type 3-2	443.25	1350	6.75	22.5	1.125	156.375
8	Type 3-3	443.25	1350	6.75	33.75	1.6875	144.5625
9	Type 3-4	443.25	1350	6.75	45	2.25	132.75
10	Type 4-1	441	1350	9	11.25	0.5625	168.1875
11	Type 4-2	441	1350	9	22.5	1.125	156.375
12	Type 4-3	441	1350	9	33.75	1.6875	144.5625
13	Type 4-4	441	1350	9	45	2.25	132.75
14	Type 5-1	438.75	1350	11.25	11.25	0.5625	168.1875
15	Type 5-2	438.75	1350	11.25	22.5	1.125	156.375
16	Type 5-3	438.75	1350	11.25	33.75	1.6875	144.5625
17	Type 5-4	438.75	1350	11.25	45	2.25	132.75

Results and Discussion

The selection of additives was based on the basic mechanism of action. The compound-modified additive includes gypsum, post-alcohol bard, and caustic soda (NaOH). The proposed additive has no analogs and is different in its quantitative composition of components. Application of caustic soda (NaOH index changes with the change in the quantitative index of post-alcohol bard) in combination with post-alcohol bard stabilizes its hydrogen index, approaching a neutral environment. The main plasticizing component is post-alcohol bard, which also has hydrophilic-hydrophobic properties. The influence of consumption of PAB to 10% demonstrated the expediency of this range, i.e. by optimizing the composition the maximum optimal range was determined. Earlier studies confirm the features of each component, and the complex synergistic effect is achieved [[19], [20]].

Studies have shown that concrete samples with the additive (PAB), when interacting with water, are not destroyed, indicating the effectiveness of this modifier. PAB, which is part of the complex modifier contains casein, which when interacting with the fine aggregate of concrete polymerizes, making additional contact films that improve the resistance of the material to the effects of water.

The object of the study was a cement-sand mortar at a constant w/c ratio = 0.4 based on unadded cement M400 (Kokshe-Cement) and using polyfractional sand packaged by 1350 grams. Figure 1 represented the test results of the strength of Type 1 (without additive composition) and with CMA, in the period of hardening 7, 14, and 28 days.

Figure 1 presents a diagram of the change in compressive strength of the tests as a function of curing time.

The reference samples of type 1 (without the use of additives) showed the lowest strength in all curing times (7, 14, and 28 days). The average strength points ranged from 22.11 to 40.83 MPa.

Samples of type 2-1 showed strength points higher than those of type 1 reference samples by 9.9% (7 days), 5.1% (14 days), and 4.8% (28 days), but 5.3% (7 days), 2.4% (14 days) and 4.8% (28 days) lower than those of type 2-2. The average strength points ranged from 24.3 to 42.8 MPa.

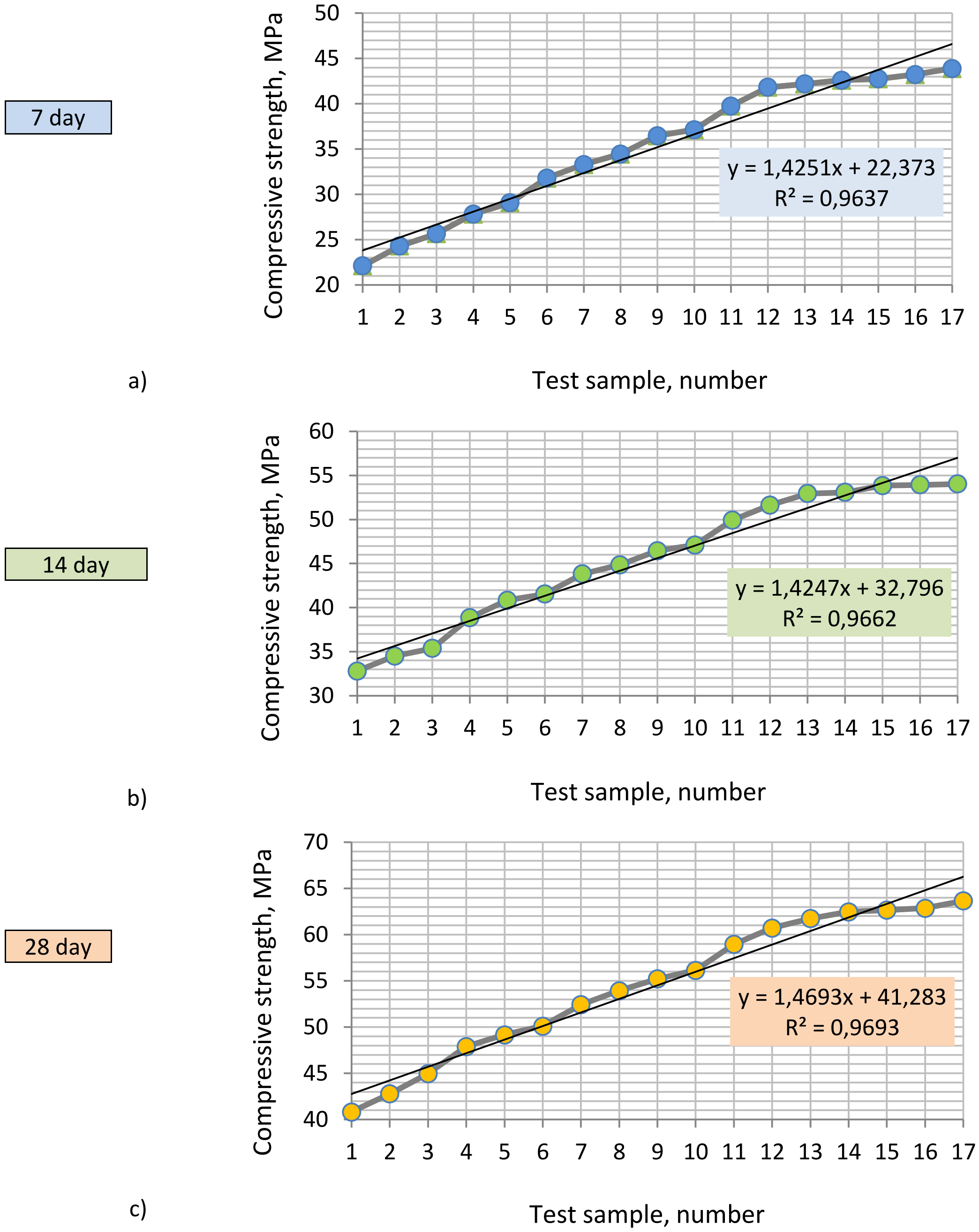

Figure 1 - Plots of growth of compressive strength of the tested samples: 7-day (a), 14-day (b), and 28 days (c)

Samples of type 2-2 showed strength points higher than those type 1 reference samples by 16.05% (7 days), 7.8% (14 days), and 10.1% (28 days), but 7.7% (7 days), 8.9% (14 days) and 6.1% (28 days) lower than those of type 2-3. The average strength points ranged from 25.66 to 44.97 MPa.

Samples of type 2-3 showed strength points higher than those type 1 reference samples by 25.8% (7 days), 18.4% (14 days), and 17.3% (28 days), but 4.2% (7 days), 4.8% (14 days) and 2.5% (28 days) lower than those of type 2-4. The average strength points ranged from 27.82 to 47.91 MPa.

Samples of type 2-4 showed strength points higher than those of type 1 reference samples by 31.4% (7 days), 24.3% (14 days), and 20.4% (28 days), but 8.5% (7 days), 1.7% (14 days) and 1.8% (28 days) lower than those of type 3-1. The average strength points ranged from 29.07 to 49.17 MPa.

Samples of type 3-1 showed strength points higher than those of type 1 reference samples by 43.8% (7 days), 26.6% (14 days), and 22.7% (28 days) but 4.4% (7 days), 5.1% (14 days) and 4.4% (28 days) lower than those of type 3-2. The average strength points ranged from 31.8 to 50.11 MPa.

Samples of type 3-2 showed strength points higher than those of type 1 reference samples by 50.5% (7 days), 33.5% (14 days), and 28.4% (28 days), but 3.3% (7 days), 2.3% (14 days) and 2.7% (28 days) lower than those of type 3-3. The average strength points ranged from 33.29 to 52.43 MPa.

Samples of type 3-3 showed strength points higher than those of type 1 reference samples by 55.8% (7 days), 36.7% (14 days), and 32.1% (28 days), but 5.5% (7 days), 3.4% (14 days) and 2.3% (28 days) lower than those of type 3-4. The average strength points ranged from 34.46 to 53.94 MPa.

Samples of type 3-4 showed strength points higher than those of type 1 reference samples by 64.9% (7 days), 41.6% (14 days), and 35.2% (28 days), but 1.8% (7 days), 1.4% (14 days) and 1.5% (28 days) lower than those of type 4-1. The average strength points ranged from 36.47 to 55.23 MPa.

Samples of type 4-1 showed strength points higher than those of type 1 reference samples by 67.9% (7 days), 43.6% (14 days), and 37.4% (28 days), but 6.5% (7 days), 5.6% (14 days) and 4.8% (28 days) lower than those of type 4-2. The average strength points ranged from 37.14 to 56.14 MPa.

Sample type 4-2 showed strength points higher than those of type 1 reference samples by 79.7% (7 days), 52.5% (14 days), and 44.4% (28 days), but 4.9% (7 days), 3.2% (14 days) and 2.8% (28 days) lower than those of type 4-3. The average strength points ranged from 39.75 to 58.96 MPa.

Sample of type 4-3 showed strength points higher than those of type 1 reference samples by 89.1% (7 days), 57.4% (14 days), and 48.7% (28 days), but 0.8% (7 days), 2.4% (14 days) and 1.6% (28 days) lower than those of type 4-4. The average strength points ranged from 41.83 to 60.72 MPa.

Samples of type 4-4 showed strength points higher than those of type 1 reference samples by 90.8% (7 days), 61.4% (14 days), and 51.2% (28 days), but 0.9% (7 days), 0.2% (14 days) and 0.2% (28 days) lower than those of type 5-1. The average strength points range from 42.19 to 61.74 MPa.

Samples of type 5-1 showed strength points highest than those of type 1 reference samples by 92.6% (7 days), 61.8% (14 days), and 53% (28 days), but 0.3% (7 days), 1.4% (14 days) and 0.2% (28 days lower than those of type 5-2. The average strength points ranged from 42.6 to 62.48 MPa.

Samples of type 5-2 showed strength points highest than those of type 1 reference samples by 93.3% (7 days), 64.1% (14 days), and 53.4% (28 days), but 1.1% (7 days), 1.4% (14 days) and 0.3% (28 days) lower than those of type 5-3. The average strength points ranged from 42.75 to 62.66 MPa.

Samples of type 5-3 showed strength points highest than those of type 1 reference samples by 95.5% (7 days), 64.4% (14 days), and 53.9% (28 days), but 1.4% (7 days), 0.1% (14 days) and 1.2% (28 days) lower than those of type 5-4. The average strength points ranged from 43.24 to 62.87 MPa.

Samples of type 5-4 showed strength points highest than those of type 1 reference samples by 98.5% (7 days), 64.7% (14 days), and 55.9% (28 days) than type 1 samples. The average strength points ranged from 43.89 to 63.66 MPa.

The analysis of the results of the conducted experiments has shown that in types 2-1 - 5-4, the compressive strength limit is within 42.8-63.66 MPa (28 days), and for the reference type 1 is 40.83 MPa, that is, this figure is 1.5 times greater than for the sample of type 1. According to the results, the hardening process occurs not only in the initial stages, but also continues to gain strength evenly in the subsequent time and to a greater extent increases the mass strength, which positively characterizes the samples with the use of CMA. It is likely that such differences in the effect on cement stone with CMA, are due to different mechanisms of action. When comparing the strength index of the sample prepared according to the sample, equal to 40.83 MPa, with the proposed compositions, which were between 42.8-63.66 MPa, it can be assumed that the samples of types 2-1 to 5-4 are of higher quality. The highest strength is observed when using the amount of additive in the amount of 2.5-7.5% of the weight of cement. This difference is explained by the modifying effect of CMA on the dispersive and morphological content of the new cement stone compounds. At the same time, the modified structure has a higher resistance to destruction.

As a consequence of the data obtained, it can be stated that the samples using CMA had a higher strength on day 7 - 24.3-43.89%; on day 14 -34.5-54.04% and on day 28 - 42.8-63.66% when compared with the reference sample. These results state that CMA increases the rate of strength gain in the early periods of hardening and contributes to high strength. Studies have shown that compositions containing 2.5 to 10% additives are the most effective, allowing for a 20% increase in the strength of the concrete. The compressive strength of such samples exceeds the value of strength without additive stone by 26.63%. The analysis of the obtained results shows that a positive effect on the kinetics of hardening has CMA on 7, 14, and 28 days of hardening, in contrast to the analog. These results state that CMA increases the rate of strength gain and contributes to high strength.

Figure 2 shows a diagram of the change in bending strength of the samples as a function of curing time. Analysis of the diagram shows that the strength of the samples increases smoothly and uniformly. Research of samples carried out with CMA increases the strength by 15-20%.

The results of behavioral studies on the bending strength of samples at 28 days of age were for:

Type 1. The test results of the reference sample were R = 5.5 MPa. The bending strength gain was 0 %.

Type 2-1. Test results of the samples with the added CMA amounted to R= 5.88 MPa. The strength gains increased by 6.9% compared to the control composition (reference sample).

Type 2-2. Test results of the samples with the added CMA amounted to R= 6.18 MPa. The strength gain increases by 12.36% compared to the control composition.

Type 2-3. Test results of the samples with the added CMA amounted to R= 6.59 MPa. The strength gain increases by 19.81% compared to the control composition.

Type 2-4. Test results of the samples with the added CMA amounted to R= 6.76 MPa. The strength gain increases by 22.9% compared to the control composition.

Type 3-1. Test results of the samples with the added CMA amounted to R= 6.89 MPa. The strength gain increases by 25.27% compared to the control composition.

Type 3-2. Test results of the samples with the added CMA amounted to R= 7.21 MPa. The strength gain increases by 31.09% compared to the control composition.

Type 3-3. Test results of the samples with the added CMA amounted to R= 7.41 MPa. The strength gain increases by 34.72% compared to the control composition.

Type 3-4. Test results of the samples with the added CMA amounted to R= 7.59 MPa. The strength gain increases by 38% compared to the control composition.

Type 4-1. Test results of the samples with the added CMA amounted to R= 7.72 MPa. The strength gain increases by 40.36% compared to the control composition.

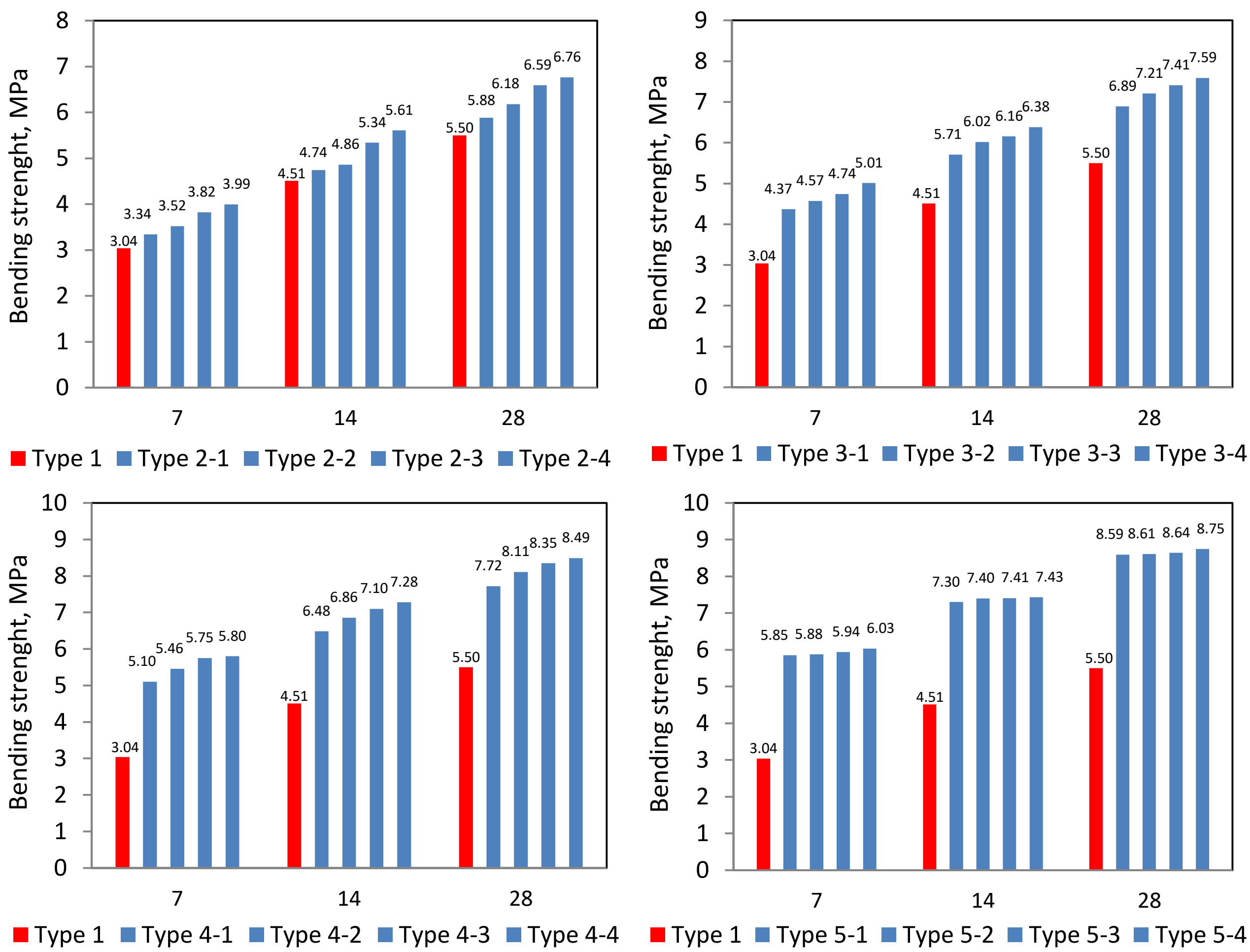

Figure 2 - Bending strength of samples at 7, 14, and 28 days

Type 4-2. Test results of the samples with the added CMA amounted to R= 8.11 MPa. The strength gain increases by 47.45% compared to the control composition.

Type 4-3. Test results of the samples with the added CMA amounted to R= 8.35 MPa. The strength gain increases by 51.81% compared to the control composition.

Type 4-4. Test results of the samples with the added CMA amounted to R= 8.49 MPa. The strength gain increases by 54.36% compared to the control composition.

Type 5-1. Test results of the samples with the added CMA amounted to R= 8.59 MPa. The strength gain increases by 56.18% compared to the control composition.

Type 5-2. Test results of the samples with the added CMA amounted to R= 8.61 MPa. The strength gain increases by 56.54% compared to the control composition.

Type 5-3. Test results of the samples with the added CMA amounted to R= 8.64 MPa. The strength gain increases by 57.09% compared to the control composition.

Type 5-4. Test results of the samples with the added CMA amounted to R= 8.75 MPa. The strength gain increases by 59.09% compared to the control composition.

The highest strength values were achieved in the compositions from 3-1 to 5-4 with an additive content of 2.5 to 7.5% of the cement weight. The highest bending strength at the age of 28 days, reaching 8.75 MPa, was obtained for the composition 5-4 (Figure 2). A slight increase in strength was observed in the bending test of beam samples made from types 5-3 and 5-4. Statistical analysis of the bending strength characteristics also showed a close relationship and relatively high convergence of individual values. In this case, the coefficient of variation does not exceed 14%; with a 95% confidence probability, the reliability coefficients do not exceed 1.17.

When the dose of CMA is increased, there is a qualitative change in the effect on strength and intensive growth of strength. In samples with different percentages of CMA (or without), the benefit of a certain amount of CMA on strength was clearly illustrated in Figures 1 and 2. During the curing process, additives have a significant effect on the bending properties of the samples, creating a strong framework in the structure, which explains the subsequent maximum increase in performance. Thus, based on the tests conducted, it was found that with the addition of CMA in the cement composition, the strength of samples tested in compression and bending, increases.

Figure 3 shows the data on the ratio of the compressive and bending strength at the age of 28 days of binders with different compositions described by the dependence $R_f = 0{,}128 \cdot R^{1{,}01}$ and characterized by the highest value of indicator R^2=0,9992, which shows a close correlation between values of compressive strength and bending strength. Thus, in terms of achieving the best results on the ratio of the compressive strength and bending strength, it is advisable to consider the composition of the binder with an additive ranging from 2.5 – 7.5% (post-alcohol bard) at a ratio of gypsum from 1 to 2%.

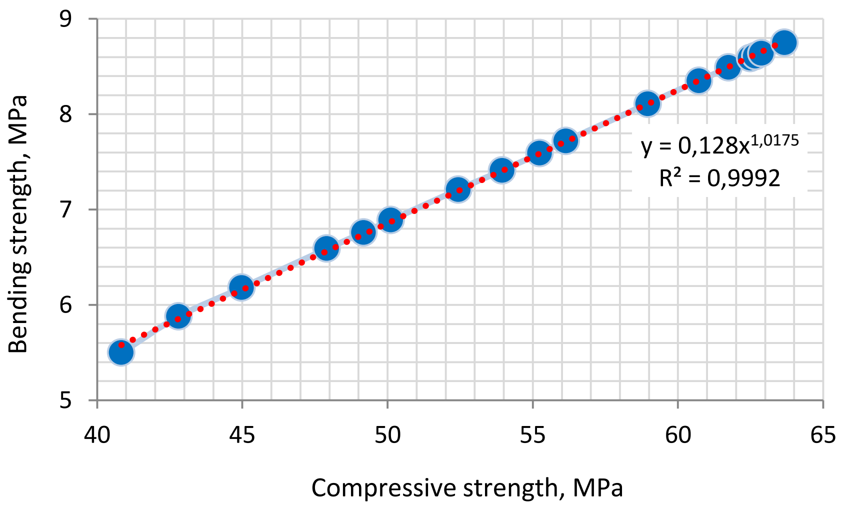

Figure 3 - Ratio of compressive and bending strengths

Conclusion

The following conclusions can be made based on the results of experimental research that the complex modified additive (CMA) shows a better water-reducing action than the composition with no additive (type 1). Based on the results of the study, the authors determined that the addition of additives reduces the quantity of water by 35%, and therefore increases the strength of the finished concrete. The results of the compression strength of the reference sample equal 40.83 MPa with the proposed compositions, which was in the range of 42.8-63.66 MPa, we can assume that the modified samples of types 2-1 - 5-4 are of higher quality. And in the case of bending strength at 28 days of age, reaching 8.75 MPa, the highest figure was obtained for the composition 5-4.

Analyzing the obtained dependencies, we can conclude that for this type of additive, the maximum effect is observed at a concentration of 2.5-7.5 % (post-alcohol bard). The additive showed an optimal positive effect, so the use of this percentage of additive is most effective in increasing the compressive and bending strength of concrete. Thus, according to the results of the research, the positive effect of CMA activation was established.

Conflict of interest. The corresponding author declares that there is no conflict of interest.

Cite this article as: Altynbekova AD, Lukpanov RE, Dyussembinov DS, Askerbekova AM, Gunasekaran Murali. Effect of a complex modified additive based on post-alcohol bard on the strength behavior of concrete. Kompleksnoe Ispolzovanie Mineralnogo Syra = Complex Use of Mineral Resources. 2023; 327(4):5-14. https://doi.org/10.31643/2023/6445.34

Спирттен кейінгі төп (барда) негізіндегі кешенді модификацияланған қоспаның бетонның беріктік сипаттамаларына әсері

[1]Алтынбекова А.Д., [1]Лукпанов Р.Е., [1] Дюсембинов Д.С., [1]Аскербекова А.М., [2] Гунасекаран Мурали

[1] Л.Н. Гумилев атындағы Еуразия ұлттық университеті, Астана, Қазақстан
[2] Зерттеу және инновация кафедрасы, Уттаранчал университеті, Дехрадун 248007, Үндістан

Мақала келді: *13 қыркүйек 2022*
Сараптамадан өтті: *14 қараша 2022*
Қабылданды: *30 қаңтар 2023*

ТҮЙІНДЕМЕ
Мақалада кешенді модификацияланған қоспаны зерттеу нәтижелерінің үшінші кезеңі, яғни осы қоспа компоненттерінің ауыспалы құрамының цементтің беріктігіне әсері келтірілген. Бұл жұмыста үлгілерді жасау әдістемесі, компоненттердің әр түрлі пайызындағы қоспаның құрамын таңдау және алынған нәтижелердің беріктік сипаттамаларының талдауы көрсетілген. Беріктіктегі өзгерістерді бағалау үшін үлгілер дайындалып, олардың 7, 14 және 28 тәулікте қалыпты ылғалдылықта қатаю кезінде қысуы мен иілуі сыналған. Тәжірибе нәтижелері көрсеткендей, қоспаларды – пластификаторларды (спирттен кейінгі төпте) қосқанда судың мөлшерін 35%-ға дейін төмендетеді, бетонның беріктігін 20%-ға арттырады. Модификацияланған үлгілердің қысу және иілу беріктігінің нәтижелері бақылау құрамымен салыстырғанда 42,80-63,66 МПа және 3,34-8,75 МПа аралығында болған ең жақсы нәтижелерді көрсетті. Зерттеу нәтижелері бойынша қоспаның қатаюы тезделеді және қоспа бетонның ерте жасында да, және жобалық жаста да (28 күн) беріктіктің өсуіне ықпал ететіні анықталды. Тәжірибе нәтижелері үлгілердің сапалық сипаттамаларын жақсарту тұрғысынан пластификаторлық қоспаларды қолдану орынды екенін көрсетті. Бетон қоспасында пластификаторларды қолдану ауыр бетонның төзімділігін және беріктігін айтарлықтай арттырады. Демек, күрделі түрлендіретін қоспаны қолдану бетонның құрылымын мақсатты түрде өзгертуге және сол арқылы физикалық-механикалық параметрлер кешенін және модификацияланған бетонның беріктігін айтарлықтай арттыруға мүмкіндік береді.
Түйін сөздер: бетон, цемент-құмның ерітіндісі, қатаю үдеткіші, спирттен кейінгі төп (барда), кешенді модификацияланған қоспа, пластификатор, иілу беріктігі, сығылу беріктігі.

	Авторлар туралы ақпарат:
Алтынбекова Алия Досжанкызы	PhD докторанты, «Өнеркәсіптік және азаматтық құрылыс технологиясы» кафедрасы, Л.Н. Гумилев атындағы Еуразия ұлттық университеті, 010000, Сәтбаев көшесі, 2, Астана, Қазақстан. E-mail: kleo-14@mail.ru
Лукпанов Рауан Ермагамбетович	PhD, «Өнеркәсіптік және азаматтық құрылыс технологиясы» кафедрасының профессорі, Л.Н. Гумилев атындағы ЕҰУ, 010000, Сәтбаев көшесі, 2, Астана, Қазақстан. Email: rauan_82@mail.ru
Дюсембинов Думан Серикович	Т.ғ.к., «Өнеркәсіптік және азаматтық құрылыс технологиясы» кафедрасының доценті, Л.Н. Гумилев атындағы Еуразия ұлттық университеті, 010000, Сәтбаев көшесі, 2, Астана, Қазақстан. Email: dusembinov@mail.ru
Аскербекова Арайлым Мырзаханкызы	PhD докторанты, «Өнеркәсіптік және азаматтық құрылыс технологиясы» кафедрасы, Л.Н. Гумилев атындағы Еуразия ұлттық университеті, 010000, Сәтбаев көшесі, 2, Астана, Қазақстан. Email: aria_09.91@mail.ru
Гунасекаран Мурали	Зерттеу және инновация кафедрасының профессоры, Уттаранчал университеті, Дехрадун, Үндістан. E-mail: murali_220984@yahoo.co.in

Влияние модифицированной добавки на основе послеспиртовой барды на прочностные характеристики бетона

[1]Алтынбекова А.Д., [1]Лукпанов Р.Е., [1] Дюсембинов Д.С., [1]Аскербекова А.М., [2] Гунасекаран Мурали

[1] Евразийский национальный университет им. Л.Н. Гумилева, Астана, Казахстан
[2] Отдел исследований и инноваций, Университет Уттаранчал, Дехрадун 248007, Индия

Поступила: *13 сентября 2022*
Рецензирование: *14 ноября 2022*
Принята в печать: *30 января 2023*

АННОТАЦИЯ

В статье представлен третий этап результатов исследования комплексной модифицированной добавки (КМД), в точности влияния вариативного состава компонентов добавки на марочную прочность цемента. В данной работе показана методология выполнения образцов, подбор состава добавки при разном процентном соотношении компонентов и анализ прочностных характеристик полученных результатов. Для оценки изменений прочности были изготовлены образцы и испытаны на сжатие и изгиб в возрасте 7, 14, и 28 суток нормально-влажностного твердения. Результаты эксперимента показали, что введение добавок - пластификаторов (послеспиртовая барда) снижает количество воды до 35%, повышая прочность бетона на 20%. Результаты прочности на сжатие и изгибе модифицированных образцов показали наилучшие результаты, которые находились в диапазоне 42,80-63,66 МПа и 3,34-8,75 МПа, по сравнению с контрольным составом. Из результатов исследований добавка, ускоряет твердение и установлено, что добавка способствует росту прочности, как в раннем возрасте, так и в проектном возрасте (28 суток). Результаты эксперимента показали, что с позиций повышения качественных характеристик образцов применение пластифицирующих добавок целесообразно. Использование пластификаторов в бетонной смеси значительно повышает стойкость и долговечность тяжелого бетона. Следовательно, применение комплексной модифицирующей добавки позволяет целенаправленно изменить структуру бетона и тем самым значительно увеличить комплекс физико-механических показателей и долговечность модифицированных бетонов.

Ключевые слова: бетон, цементно-песчаный раствор, ускоритель твердения, комплексная модифицирующая добавка, послеспиртовая барда, пластификатор, прочность при изгибе, прочность на сжатие.

	Информация об авторах:
Алтынбекова Алия Досжанкызы	Докторант PhD, Кафедра «Технология промышленного и гражданского строительства», ЕНУ им. Л.Н.Гумилева, Астана, Казахстан. E-mail: kleo-14@mail.ru
Лукпанов Рауан Ермагамбетович	PhD, Профессор кафедры «Технология промышленного и гражданского строительства», ЕНУ им. Л.Н.Гумилева, 010000, ул. Сатбаева 2, Астана, Казахстан. Email: rauan_82@mail.ru
Дюсембинов Думан Серикович	К.т.н., Доцент кафедры «Технология промышленного и гражданского строительства», ЕНУ им. Л.Н.Гумилева, 010000, ул. Сатбаева 2, Астана, Казахстан. Email: dusembinov@mail.ru
Аскербекова Арайлым Мырзаханкызы	Докторант PhD, Кафедра «Технология промышленного и гражданского строительства», ЕНУ им. Л.Н.Гумилева, 010000, ул. Сатбаева 2, Астана, Казахстан. Email: aria_09.91@mail.ru
Гунасекаран Мурали	Профессор отдела исследований и инноваций, Университет Уттаранчал, Дехрадун, Индия. E-mail: murali_220984@yahoo.co.in

References

[1] Ngugi HN, Mutuku RN, Gariy ZA. Effects of sand quality on compressive strength of concrete: A case of Nairobi County and Its Environs, Kenya. Open Journal of Civil Engineering. 2014; 04(03):255- 273. https://doi.org/10.4236/ojce.2014.43022

[2] Gora J, Piasta W. Impact of mechanical resistance of aggregate on properties of concrete. Case Studies in Construction Materials. 2020; 13:e00438. https://doi.org/10.1016/j.cscm.2020.e00438

[3] Hong L, Gu X, Lin F. Infl uence of aggregate surface roughness on mechanical properties of interface and concrete. Construction and Building Materials. 2014; 65:338-349. https://doi.org/10.1016/j.conbuildmat.2014.04.131.

[4] Kharchenko AI, Alekseev VA, Kharchenko IYa, Bazhenov DA. Structure and properties of fi ne concretes based on composite binders. Vestnik MGSU [Proceedings of Moscow State University of Civil Engineering]. 2019; 14(3):322-331. https://doi.org/10.22227/1997-0935.2019.3.322- 331 (in Russ.).

[5] Rakhimbaev ShM, Tolypina NM, Tolypin DA. Sravnitel'naya ustoychivost' betonov s zapolnitelyami i napolnitelyami razlichnogo sostava [Comparative stability of concrete with aggregates and fi llers of different composition]. Novosti universiteta. Stroitel'stvo [University news. Construction]. 2018; 10:13-21. https://doi.org/10.32683/0536-1052-2018-718-10-13-21 (in Russ.).

[6] Barannikov MV, Polyakov IV, Vinogradova LA, Polyakov VS. A multifunctional additive for heavy concretes. Vestnik MGSU. 2022; 17(6):720-726. https://doi.org/10.22227/1997-0935.2022.6.720-726

[7] Kalashnikov VI. How to transform the old generation concrete in high-performance concretes of new generation, Concrete and reinforced concrete, Equipment, Materials, Technologies. 2012; 1:82-89

[8] Marceau S, Lespinasse F, Bellanger J, Mallet C. Microstructure and mechanical properties of polymer-modified mortars, European Journal of Environmental and Civil Engineering. 2012; 16:571-581. https://doi.org/10.1080/19648189.2012.675148

[9] Qingyu C, Wei S, Liping G, Guorong Z. Polymer-modified concrete with improved flexural toughness and mechanism analysis, Journal of Wuhan University of Technology-Materials Science Edition. 2012; 27:597-601. https://doi.org/10.1007/s11595- 012-0512-5

[10] Muhammad NZ, Keyvanfar A, Abd. Majid MZ, Shafaghat A, Mirza J. Waterproof performance of concrete: A critical review on implemented approaches, Construction and Building Materials. 2015; 101:80-90. https://doi.org/10.1016/j.conbuildmat.2015.10.048

[11] Plank J, Sakai E, Miao CW, Yu C, Hong JX. Chemical admixtures, Chemistry, applications and their impact on concrete microstructure and durability,Cement and Concrete Research.2015;78:81-99.https://doi.org/10.1016/j.cemconres.2015.05.016

[12] Tian Y, Shuaifeng S, Shuguang H. Mechanical and dynamic properties of high strength concrete modified with lightweight aggregates presaturated polymer emulsion, Construction and Building Materials. 2015; 93:1151-1156

[13] Chistov YuD, Tarasov AS. Development of multi-mineral binders, Russian Chemical Journal. 2003;4:12-17

[14] Tarakanov OV, Belyakova EA, Yurova VS. Complex organomineral additives with hardening accelerator. Solid State Phenomena. 2018; 284:929-935. https://doi.org/10.4028/www.scientifi c.net/SSP.284.929

[15] Smirnov IR. Kompleksnyye dobavki k betonu na osnove veshchestv organicheskoy i mineral'noy prirody [Complex additives to concrete based on substances of organic and mineral nature]. Nauka i tekhnika [Science and Technique]. 2022; 21(l):57-62. https://doi.org/10.21122/2227-1031-2022-21-1-57-62 (in Russ.).

[16] Bessaies-Bey H, Khayat KH, Palacios M, Schmidt W, Roussel N. Viscosity modifying agents: Key components of advanced cement-based materials with adapted rheology. Cement and Concrete Research. 2022; 152:106646. https://doi.org/10.1016/j.cemconres.2021.106646

[17] Al-Khazraji AA. Use of plasticizers in cement concrete. Journal of Advanced Research in Dynamical and Control Systems. 2020; 12(3):599-607. https://doi.org/10.5373/JARDCS/V12I3/20201229.

[18] Garzón-Agudelo PA, Palacios-Alvarado W, Medina-Delgado B. Impact of plasticizers on the physical and structural properties of concrete used in constructions. Journal of Physics: Conference Series. 2021; 2046(1):012069. https://doi.org/10.1088/1742- 6596/2046/1/012069

[19] Altynbekova A, Lukpanov R, Dyussembinov D, Askerbekova A, Tkach E. Effect of a complex modified additive on the setting time of the cement mixture. Kompleksnoe Ispolzovanie Mineralnogo Syra = Complex Use of Mineral Resources. 2022; 325(2):29-38. https://doi.org/10.31643/2023/6445.15

[20] Altynbekova AD, Lukpanov RE, Yenkebayev SB, Dyussembinov DS, Yerzhanova NK. Bystrotverdeyushchiy udoboukladyvayemyy beton dlya proizvodstva buronabivnykh [Fast-hardening workable concrete for the production of bored]. Construction and reconstruction Construction and reconstruction [Stroitel'stvo i rekonstruktsiya Building and Reconstruction]. 2022; 2:99-111. https://doi.org/10.33979/2073-7416-2022-100-2-99-111 (In Russ.).