Investigation of Alkali Cements and Concrete Based on Local Raw Materials

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ABSTRACT

The growth of modern urban planning places high demands on the quality of raw materials, including concrete, which are directly related to the quality of building structures. Therefore, the production of quality concrete, the creation of new cement compositions and energysaving technologies are among the priorities. At the same time, it is important to improve the physical and chemical properties of concrete based on the use of local mineral raw materials. The article presents the analysis of active mineral admixtures and the results of concrete tests using tuffite.

Keywords: ***alkaline cements, alkaline concrete, binders, water repellency, firing time, tuffite, clinker.***

INTRODUCTION

It is known that concrete is one of the main building materials and is widely used in the construction as constructive elements of buildings and structures. Concrete is the main element that determines their durability, strength and resource of use in construction structures. However, in case of violation of the technology of preparation and the hardening process of concrete products or the use of low-quality components for the preparation of concrete, premature absorption of structures is observed. This in turn negatively affects the durability and use life of building constructions and structures. The high water absorption of concrete leads to the fact that some of the components that make up the hardening of concrete in it, first of all, kaltsium gidratoxide ($Ca(OH)_2$), are washed off. The washing of the components in this order is called corrosion of the cement stone in concrete, which annually causes a great deal of damages to building products and structures. If the concrete structure is leaking not only pure water, but also other salt water elements that adversely affects the structure of concrete alloy, the corrosion of the cement stone in the concrete increases several times. These elements react with the elements that harden the cement, forming quickly absorbable and durable compounds. The most convenient way to increase the plasticity and frost resistance of concrete products is to modify cement, that is, enrich its composition with chemical and natural mineral additives. Cement in this regard is the most convenient component that can improve the properties of concrete.

In addition to reducing the plasticity of concrete and increasing its resistance to frost, its effectiveness increases several times if additives are introduced from local raw materials, which are contained in large quantities in it. This problem was investigated and the main focus was as followings:

- use of domestic raw materials types, industrial waste and residues for cement modification;
- to examine the alloy genetics of modified cement added concrete products;
- research on improved cement water absorption and frost resistance;

- to determine the optimal parameters of enrichment of concrete with additives and to clarify the impact of additives on the structure and hydration processes of cement stone formation.

Our research was carried out on the basis of tuffitesamples taken from Karmana mine, Navai region, Uzbekistan and wollastonitesamples taken from Koytash mine, Jizzakh region, Uzbekistan.

Tuffite is a mountaineer consisting of a mixture of volcanic material (slag, ash, pumice, fragments of solid mountain ash) and its sedimentary material, formed as a result of volcanic eruption.

Figure 1.Tuffite.

Tuffite is an active mineral substance. But when mixed with water, it does not form an artificial stone. As a rule, in order to activate it, a high-grade material-Portland cement clinker is put into its composition. During the tests, when tuffite was mixed with Portland cement clinker from 30% to 70%, there was an opportunity to increase mineral activity by more than 20%. The components were mixed with a solution of potassium-containing liquid glass in water with a density of 1250 or 1300 kg/m3, after grinding in a ball mill. The mixture was prepared in different ways, including for the purpose of comparison, the contents were also mixed with water and injected. The results of the study are presented in the Table 1. For the purpose of comparison, the results obtained when the contents studied are mixed with water are also presented in this table.

The experiments performed showed that the addition of alkalis to the composition of pozzolan Portland cement sharply reduced the time of thickening. Due to this, the conditions of hydration and hardening of the compound composition deteriorated, resulting in a violation of the structure of the cement stone and a low level of consistency.

MAIN PART

It is known that binders without clinker in their composition do not solidify both in water and in the water solution of a liquid bottle. The silicate module of the liquid bottle is equal to 1, the density of its solution in water is 1250 kg/m3, when the amount of the clinker is increased by 30% in the binding composition, the thickening begins in 12 minutes and ends quickly after 5 minutes. Such a rapid solidification of the mixture does not correspond to the requirements of concrete and reinforced concrete technology. When the amount of Portland cement clinker increased by 50 and 70%, the binding system would be very quickly thickened. This is due to the fact that in the hydration of alkali cements based on slag-type aluminosilicate with a large amount of calcium in its composition, there is a process of mutual exchange of cations between alkali component and aluminosilicate component. As a result, low-base hydro-silicate of calcium and fresh alkali are formed. Then the fresh alkali reacts with the bottled phase of the aluminosilicate and continues until the calcium in it becomes completely low-base hydro-silicates. And at the end of the hydration, it connects with the remains of alkaline aluminosilicate, forming hydro-aluminosilicates with sodium or potassium. Due to the fact that the composition of tuffite is the same as the composition of the slag, even when tuffite is used as an aluminosilicate, it is possible to observe the course of such processes. In our opinion, when tuffite is used as an aluminosilicate-forming, calcium-based hydro-silicates will not be enough to strain the system, since its content is low (not more than 12 %) of calcium oxide.

Scientific sources have found that the thickening of the Portland cement is due to the hydration of the clinker-containing three-calcium aluminum. According to Portland cement technology, this mineral clinker is in a very active state when it cools down quickly. When Portland cement powder is mixed with water, it initially reacts with water to this mineral and leads to its thickening, but has little effect on the increase in the strength of the Portland cement stone. Therefore, in order to increase the thickening time of the Portland cement, a gypsum stone is laid on it in the process of clinking. When the Portland cement powder is mixed with water, this material forms a thin and dense membrane consisting of three calcium hydro-sulfa-aluminates minerals around the cement particles, combined with three calcium aluminum and water. As a result, the interaction of water with cement particles temporarily stops, and the time of cement thickening is also slightly delayed.

But first of all, this process can not lead to the rapid thickening of the alkali-binding system, which we are studying, in which there is a lot of high-base Portland cement clinker in the composition. Secondly, in its composition, gypsum stone is also not formed. In our opinion, rapid thickening is caused by a large amount of three-calcium and two-calcium silicates contained in Portland. Because these minerals quickly enter the process of cation exchange with high alkaline environment components. As a result, in the superficial part of the binder, the coagulation process occurs quickly, that is, thickening develops quickly.

Hence, it can be concluded that even the thickening time of the binder can be slowed down if the alkali organizer slows down the reaction time with the high-base minerals of the Portland cement clinker.

Table 1.Thickening time of Portland cement with alkaline active mineral.

№	**Tuffite, %**	**Clinker, %**	**Liquid glass**		**Thickening time, hour, minute**	
			M_c	**S, kg/m^3**	**start**	**finish**
1	70	30	1	1250	0-12	0-17
2	70	30	2	1300	0-00	0-00
3	70	30	3	1300	0-00	0-00
4	70	30	water	1000	4-40	-

5	100	0	1	1250	not thicken	not thicken
6	100	0	2	1300	not thicken	not thicken
7	100	0	3	1300	not thicken	not thicken
8	100	0	water	1000	not thicken	not thicken
9	30	70	1	1250	0-00	0-00
10	30	70	2	1300	0-00	0-00
11	30	70	3	1300	0-00	0-00
12	30	70	Water	1000	2-10	4-40
13	50	50	1	1250	0-00	0-00
14	50	50	2	1300	0-00	0-00
15	50	50	3	1300	0-00	0-00
16	50	50	water	1000	2-20	-

Scientists of Samarkand State Architecture and Civil engineering Institute, Uzbekistan have proved that to solve this problem, the introduction of active mineral material not directly into the liquid bottling system, but also through the absorption of liquid into the bottle, is a good effect. In the conducted studies, an aqueous solution of an alkaline-forming liquid bottle was introduced into the composition of the binder, impregnated with active mineral material (6, 10, 12). This was done as follows. The active mineral was impregnated with an aqueous solution of liquid glass with a density of 1250 and 1300 kg/m3, then dried and together with the Portland cement clinker it seemed to be grinded in a ball mill. The comparative surface of the resulting powder was recorded on the PSX-2 detector at about 300 m^2/kg. Then mixed with water, forming a soft-looking aluminosilicate. The results obtained are presented in the Table 2.

The analysis of the results presented shows that the introduction of liquid glass into the binder lasts the time of the onset of alkaline pozzolan Portland cement thickening for 20 and 30 minutes, which corresponds to the requirements of the technology of preparation of concrete and reinforced concrete. At the same time, the increase in the content of the binder in the Portland cement clinker accelerates the thickening time. Through experiments, the thickening of the alkali-based binder with a density equal to 1250 kg/m^3 is combined with the silicate module 1 hour 30 minutes later, 50% 1 hour 22 minutes later and 70% 1 hour 18 minutes later then the beginning was determined. Such order is observed even when the silicate module of the liquid bottle is 2 and 3, but the thickening time in the bun is further reduced. For example, if the thickening of the alkali-based binder, the density of which is 30 kg/m^3 silicate module when the glycerol is laid in 30, 50 and 70% amounts, starts after 1 hour 20 minutes, 1 hour 15 minutes and 1 hour 10 minutes respectively, 45, 42 and 38 minutes when the silicate module is three.

Table 2.The time of thickening of Alkaline active mineral of Portland cement.

№	Tuffite, %	Clinker, %	Liquid glass		Thickening time, hour and minute	
			M_c	S, kg/m³	start	finish
1	70	30	1	1250	1-30	2-30
2	70	30	2	1300	1-20	2-00
3	70	30	3	1300	0-45	1-22
4	100	0	1	1250	Not thicken	Not thicken
5	100	0	2	1300	Not thicken	Not thicken
6	100	0	3	1300	Not thicken	Not thicken
7	30	70	1	1250	1-18	2-21
8	30	70	2	1300	1-10	1-50
9	30	70	3	1300	0-38	1-20
10	50	50	1	1250	1-22	2-25
11	50	50	2	1300	1-15	1-55
12	50	50	3	1300	0-42	1-20

Note: * the liquid glass is absorbed into the tuffite.

This means that the thickening time of alkali pozzolan Portland will depend on the amount of clinker and the silicate module of the liquid bottle when the alkali-forming liquid is introduced through the active mineral material of the bottle. The decrease in the density of the silicate module and aqueous solution of the liquid glass slows down the thickening time of the alkali cement dough. This situation can be explained as follows. In the process of hardening of the binder, the liquid contained in the active mineral material is gradually absorbed into the solution over time, forming a highly alkaline environment inside the hardening system and creating favorable conditions for the process of hydration.

Thus, based on the researches, the inclusion of silicate Alkali in the composition of alkali cement through active mineral materials reduces the thickening time of alkali binder to periods corresponding to the requirements of concrete and reinforced concrete preparation technology.

The creation of this law necessitated the revision of the physical-mechanical properties of the formed alkali cements. To do this, a region-samples of the size 40x40x1x160 mm were prepared from the mixture with the content of "connecting\sand=160\3" of normal thickness. Part of the samples After 2 or 4 hours 3+6+2 in clock mode it was vaporized at a temperature of 85 or 90°C, and the consistency limit in the compression was determined. Other specimens were stored in water for another 27 days after thickening in a mold for one day, and then the consistency limit in compression and bending was determined. The results obtained are presented in the Table 3.

3-жадвал. The strength limit of Portland cement withAlkaline active mineral.

Contents on the Table 3.2	**The strength limit in compression, in MPa**	
	After evaporation	**After thickening in water for 28 days**
1	55,2	24,6
2	58,0	25,9
3	52,3	23,8
7	64,0	40,2
8	65,7	41,2
9	60,9	36,0
10	59,3	35,0
11	60,2	35,5
12	56,5	32,1

In the table above, it has been shown that an alkaline mineral additive Portland Cement (up to 600 brand) with a high degree of purity (up to 600 brand) is formed in silicate-containing formers. This means that the consistency limit of the evaporated samples was higher than the consistency limit of the samples that were hardened under normal conditions.

For example, The If the silicate module with 30, 50 and 70% Portland cement clinker in the composition is equal to 1, the strength limit after 28 days of alkali cement is equal to 24.6, 35.0 and 40.2 mPa, then the vaporized samples will be 1.5–2 times higher, that is, it is 55.2, 59.3 and 64.0 mPa respectively. Similar results are observed when silicate alkali-forming agents with silicate modules 2 and 3 are used. In our opinion, in the process of evaporation, the transition of the alkali organizer from the active mineral composition to the solution is accelerated, which in turn leads to the acceleration of the process of solidification and increases its durability. Only an increase in the amount of Portland cement clinker in the system will not lead to a significant increase in its durability. Therefore, it is appropriate to conclude that the optimal amount of the Portland cement clinker is 30 or 50%.

The highest results were obtained when using disilicate when studying the effect of the silicate module on the strength of alkali active mineral substances Portland cement in silicate alkali organizers. For example, a evaporated alkali-active mineral with a content of 30% Portland clinker was observed to have a consistency limit of Portland cement when the silicate module of the silicate alkali organization was 2, the silicate module was 2,8mPa higher than 1, and the silicate module was 5,7 mPa higher than 3, that is, respectively 58,0; Such order also appeared when the Portland cement clinker was reduced by 50 and 70%.

In addition, the increase in the amount of alkali-active mineral content of Portland cement clinker does not lead to a sharp increase in strength, which means that the optimal amount of Portland clinker lies around 30 or 50%.

Thus, as a result of the research, thickening time on the basis of silicate alkali-forming was obtained from cement of the brand M400 or M600, which corresponds to the technology of concrete and reinforced concrete.

The above-described regularity was observed even when using non-ferrous salts of alkali metals, for example, a mixture of soda or soda-sulfate, as an alkali-forming agent in Alkali-binding substances. The results of the study presented in the Table 4 show that the correct conclusion has been drawn.

Table 4. Thickening time of Portland cement with Alkaline active minerals.

№	**Tuffite, %**	**Clinker,%**	**Alkali-formingtype**	**Thickening time, hour and minute**	
				start	**finish**
1	70	30	Soda	0-20	0-40
2	70	30	SSM*	0-25	0-45
3	70	30	Water	4-40	-
4	100	0	Soda	Not thicken	Not thicken
5	100	0	SSM*	Not thicken	Not thicken
6	100	0	Water	Not thicken	Not thicken
7	30	70	Soda	0-06	1-10
8	30	70	SSM*	0-08	0-12
9	30	70	Water	2-10	4-40
10	50	50	Soda	0-08	0-12
11	50	50	SSM*	0-10	0-14
12	50	50	Water	2-20	-

Note: * soda-sulfatemixture.

In the researches, a mixture of technical soda with a density of 1200 kg/m^3 and soda-sulfate consisting of Na_2CO_3-40, Na_2SO_4-51, NaOH-2 and NaCl-7% by mass was used as an alkaline solution.

The results obtained showed that tuffite's viscosity activity was very low when mixed with water, under natural conditions such a system did not solidify. The results obtained are consistent with the findings of the study presented above. This will speed up the system the time of thickening when Portland cement with active mineral substances, such as the Portland cement clinker, but the consistency limit and coldness of such a binder will be lower, as the literature analysis suggests. As indicated in the table, the thickening of such a binder begins after 4 hours 40 minutes, respectively, 2 hours 20 minutes, and 2 hours 10 minutes, when the Portland cement clinker in the amount of 30, 50 and 70% is put into the tuffite-clinker system and aralyzed with water.

In addition, as is known, alkaline binders based on the causative salts of active mineral substances, in particular tuffite and alkali metals, do not have a high consistency limit, the activity of such binders does not exceed 20 mPa (10). The composition of these can be increased from 30% to 70% by inserting a high-based additive-Portland clinker, and the durability of which is up to 50 or 60 mPa. But the alkaline cement dough quickly thickens, as if the silicate salts of alkali metals were used. For example, if the alkaline cement content on the basis of tuffite and soda is added 30% Portland cement clinker, the thickening of the cement dough begins after 20 minutes, 50% is laid after 8 minutes and 70% is laid after 6 minutes. The same order was observed when a soda-sulfate mixture was used as an alkali-forming: 30% Portland cement clinker was introduced into the composition of alkali cement based on a mixture of tuffite and soda-sulfate, the cement dough was started 25 minutes later, 50% was introduced 10 minutes later and 70% was introduced 8 minutes later. The time of thickening of alkali Cements also depends on the type of non-ferrous salts of alkali metals used. For example, the thickening of the cement dough when the composition was arable with 70% tuffite and 30% water of the aluminosilicate maker, consisting of a Portland clinker, began 4 hours 40 minutes after mixing with a water solution of 1200 kg/m^3 of the soda-sulfate mixture, 25 minutes after mixing and 20 minutes after mixing with such a solution of soda. Such legislation was observed even when the amount of Portland cement clinker was 50 and 70%, but the time of thickening in these compounds was much shorter. Thickening of the cement dough when mixing 50% clinker-containing aluminosilicate with water on a tuffite-based binder begins after 2 hours 20 minutes, after 10 minutes when mixing with a soda-sulfate mixture and after 8 minutes when mixing with a soda solution. These indicators were 2 hours 10 minutes, 2 hours 8 and 2 hours 6 minutes respectively, while 70% clinker was adjusted.

As a result of the research, it can be concluded that the thickening time of the cement dough, regardless of the type of the alkali organizer, is reduced when a high-base additive is added to the composition of alkali-active mineral compounds binders.

This phenomenon was explained above as follows: the rapid thickening of the connecting system under study is caused by a large amount of three-calcium and two-calcium silicates contained in Portland cement. These minerals enter the process of rapid cation exchange with alkali component in a highly alkaline environment, mainly in the surface part of the binder, rapid coagulation occurs. Thickening happens quickly.

This means that just as alkali-forming uses silicate salts of alkali metals, the bondholder can also slow down the thickening time if the non-alkali-forming Portlandcement clinker slows down the reaction time with high-base minerals. To do this, it is desirable to introduce a stretchy alkali organizer into the rigorous system through active mineral substances, for example, by impregnation into it.

One of the main indicators of the binding substance is the time between the beginning and the end of thickening. The shorter this intermediate time, the higher the quality of the connector. Alkali cement, developed according to this indicator, is sharply different from other conventional binders. For example, if the difference between the beginning and end of the thickening of the Portland cement dough is from 3 to 6 hours, then in the alkali-active mineral material Portland, the difference is from 40 minutes to 1 hour 30 minutes.

Analysis of the results obtained showed that the thickening Times of alkali Cements with a content of 30 and 50% Portland cement clinker are relatively close. This is explained as follows: the alkali-forming, contained in the active mineral substance during the hardening process, regardless of its type, gradually passes into the solution and forms a highly alkaline environment inside the solidified medium, under which the crystallization of low-base calcium hydro-silicates slows down.

Thus, the thickening time of the connecting substance is at the required level when the alkali-active mineral component of the silicate and non-alkali-forming is introduced into the Portland cement by means of the active mineral substance. The results obtained are presented in Table 8.

Analysis of these results shows that 300 or 400 alkaline cements were obtained from the study. It can be seen that the activity of alkaline cements depends on the composition, amount and alkali conditions of alumocytic and alkaline compounds. For example, the hardness of Portland cement with alkaline active mineral substance on soda base is higher than that of Portland cement, with alkali active sulphate sulfate mixture, regardless of clinker volume and sample hardness: if the amount of Portland Cement is 30%, the difference in the vaporized samples is 0,8 mPa, while 28 days in the solids is 0,9 mPa, when 70% clinker is placed, this difference is 7,3 and 0,9 mPa, respectively, in the conditions of the alloy.

Table 5.The strength limit of Portland cement withAlkaline active mineral.

Contents on the Table 3.5	**The strength limit in compression, in mPa**	
	After evaporation	**After thickening in water for 28 days**
1	33,7	17,9
2	32,9	17,0
3	48,1	30,2
4	40,8	29,3
5	38,3	26,0
6	35,0	23,1

It should be noted that the alkali active mineral on the basis of soda is Portland, when the consistency limit is 50% of the clinker, it is 2,9 or 3,3 mPa higher than the alkali binder on the basis of a soda-sulfate mixture, depending on the alloy conditions of the samples.

The consistency limit of the evaporated samples was even higher than the consistency limit of the samples, which was hardened in 28 days wet conditions. It turned out that the difference is in the 1,5 or 1,8 range. Indeed, during evaporation, the transition from the composition of the alkali-active mineral to the solution is accelerated and the time of hardening of the binder is reducedtiradi in vanatija the strength of the artificial stone increases.

The results obtained showed that the optimal amount of Portland cement clinker lay around 30 or 50%, since it does not lead to a sharp increase in strength even when the clinker increases the amount by 50%.

Thus, as a result of the researches conducted, 300 or 400 branded Portlandcement of alkali-active mineral material, the thickening time was satisfactory on the basis of non-alkaline-forming.

The experience of determining the optimal composition of the prepared cement was carried out using mathematical methods (7). To do this, the effect of tuffit-clinker ratio, isothermic storage time and temperature on the consistency limit after evaporation of alkali cement, 28 days of evaporated samples after drying under natural conditions were studied. In the researches, a method of conducting a full-fledged experiment was used. The experimental results of the factor change thresholds, the matrix of planning, and the strength limit at post-evaporation compression are presented in Tables 6, 7 and 8.

Table 6.Limits of Factor changes.

Factors	**Unitofmeasurement**	**Amount**	**Step of change**	**Layer**		**Note**
				Low	**High**	
Tuffite-clinker ratio	-	50:50	20	30:70	70:30	Z_2
Isothermicstoragetime	hour	3	3	0	6	Z_3
Isothermicstorage temprature	K	350	18	332	368	Z_1

Table 7.Experiment planning Matrix.

Experiment №	**Planning Matrix**								**Experiment Matrix**		
	X_0	X_1	X_2	X_3	X_1X_2	X_1X_3	X_2X_3	$X_1X_2X_3$	X_1	X_2	X_3
1	+	-	-	+	+	-	-	+	332	30:70	6
2	+	-	+	+	-	-	+	-	332	70:30	6
3	+	+	-	+	-	+	-	-	368	30:70	6
4	+	+	+	+	+	+	+	+	368	70:30	6
5	+	-	-	-	+	+	+	-	332	30:70	0
6	+	-	+	-	-	+	-	+	332	70:30	0
7	+	+	-	-	-	-	+	+	368	30:70	0

8	+	+	+	-	+	-	-	-	368	70:30	0

Table 8.Experimental results of strength limits in post-vapor compression

Experiment №	**У$_1$**	**У$_2$**	**У$_3$**	**У$_4$**	**У$_{1cp}$**
1	39,1	38,2	40,1	40,0	39,35
2	32,1	33,0	33,2	32,0	32,5
3	59,2	58,2	59,0	59,1	58,8
4	41,2	41,5	41,0	40,5	41,1
5	35,1	35,5	35,0	34,8	35,1
6	29,2	29,0	29,5	29,0	29,1
7	49,1	49,0	48,6	49,2	48,9
8	33,2	33,0	33,5	33,4	33,2

Before the release of the regression equation, it was checked that the results obtained were the probability of return and the consistency (adequacy). The results of the calculations are presented in the Table 9.

Table 9. Return of results: to check the validity and suitability (adequacy)of the results

№	**Checking the probability of Return of results**		**Checking proportionality**		
	$\sum$ (У-У$_{cp}$)^2	S^2	У$_1$	У$_{cp}$-У$_1$	(У$_{cp}$-У$_1$)^2
1	2,38	0,79	39,3	0	-
2	1,15	0,38	32,5	0	-
3	0,65	0,21	58,8	0	-
4	0,54	0,18	41,1	0	-
5	0,26	0,086	35,1	0	-
6	0,19	0,063	29,1	0	-
7	0,63	0,21	48,9	0	-
8	0,17	0,056	33,2	0	-
$\sum$	6,07	1,975			-

The formula for checking the probability of recurrence of results is as follows:

(1) $S_i^2 = \frac{1}{m}\sum_{i-1}^{m}(Y_i - Y)^2$

In accordance with the above (1) formula, the probability of Return of the results was calculated. Calculations showed that $G_{кр} = 0,4377 > 0,38$. So it turned out that the probability of re-receipt of dispersions is sufficient.

We determine the Fisher criterion using the proportionality Formula(2):

$$S_k^2 = \frac{1}{N-d}\sum_{1}^{N}(\bar{y}-y)^2 \quad = \frac{0}{8-3} = 0$$

$$S_{[k.o]}^2 = S_{[y]}^2 = \frac{6{,}07}{8 \text{ x } 3} = 0{,}27$$

$$F = \frac{S_k^2}{S_{k.o}^2} = \frac{0}{0{,}27} = 0$$

$$F = 0 \; < F_{кр} = 6{,}661$$

So, the results obtained are identical.

As a result of the calculations, the isothermal storage time and temperature of the boundary of the compressive strength of the alkali Cement after evaporation, the mathematical models of the bond compatibility(adequate) from the tuffite-clinker ratio were obtained, and their graphical interpretation was created.

In the studies, it was considered that the selected silica was associated with the time of the beginning of the process of thickening of alkali cement. The results from the experiments are presented in Table 10.

For this case, both the probability and compatibility(adequacy) of the results obtained before the release of the regression equation were checked. The results of the calculations are presented in the Table 10.

Table 10. The time of onset of the thickening process according to the results of the experiment

Experiment №	**$У_1$**	**$У_2$**	**$У_3$**	**$У_4$**	**$У_{2ср}$**
1	22	22	23	22	22,2
2	45	44	45	46	45
3	22	23	23	24	23
4	45	45	46	45	45
5	22	23	23	24	23
6	45	45	46	45	45
7	22	23	23	24	23
8	45	45	46	46	45,5

Table 11.Check the probability and compatibility (adequacy) of retrieving results.

№	**Probabilityofretrievingresults**	**Adequacyoftheresults**

	∑ (У-Уc$_p$)^2	S^2	У$_1$	У$_{cp}$-У$_1$	(У$_{cp}$-У$_1$)^2
1	0,76	0,25	22,2	0	-
2	1,00	0,33	45	0	-
3	1,00	0,33	23,0	0	-
4	1,00	0,33	45,0	0	-
5	1,00	0,33	23,0	0	-
6	1,00	0,33	45,0	0	-
7	1,00	0,33	23,0	0	-
8	1,00	0,33	45,5	0	-
∑	7,76	2,56			-

Regression coefficients were calculated using the following formula:

$$b_i = \frac{1}{N}\sum_{i=1}^{N} Xq_i - Yq$$

Calculated regression coefficients are presented in a table form (Table 17).

Table 12.Regression coefficients.

b_0	b_1	b_2	b_3	b_1 b_2	b_1 b_3	b_2 b_3	b_1b_2 b_3
33,9	0,16	11,16	-0,16	-0,035	0,0375	0,0375	-0,16

As a result of the calculations, it was determined that the beginning of the thickening of alkali cement was only due to the ratio of tuffite-clinker, and the mathematical model of this bond compatibility(adequate) was obtained. A graphical interpretation of this mathematical model was created.

It was considered that the selected ores are tied to the boundary of the consistency of alkaline cement in the compression for 28 days after steaming. The results from the experiments are presented in the Table 13.

The probability and appropriateness(adequacy)of retrieving the results obtained was checked.The results of the calculations are presented in the Table 14.

Table 13. Experimental results of strength limit at 28 days post-evaporation

Experiment №	**У$_1$**	**У$_2$**	**У$_3$**	**У$_4$**	**У$_{3cp}$**
1	62,0	62,3	61,9	62,2	62,1
2	41,0	41,5	41,3	41,0	41,2
3	66,1	65,6	65,9	66,0	68,9

4	50,0	50,1	50,2	50,5	50,2
5	61,0	61,2	61,3	61,5	61,2
6	40,0	40,2	40,3	40,6	40,2
7	65,0	65,8	65,2	65,0	65,2
8	50,5	50,0	50,2	50,4	50,2

Table 14.Checking the adequacy and probability of retrieving the results

Experiment №	**Probability of retrieving the results**		**Checking the adequacy of results**		
	$\sum (У-У_{ўр})^2$	S^2	$У_1$	$У_{ўр}-У_1$	$(У_{ўр}-У_1)^2$
1	0,1	0,033	62,1	0	-
2	0,18	0,06	41,2	0	-
3	0,14	0,046	65,9	0	-
4	0,14	0,046	50,2	0	-
5	0,14	0,046	61,2	0	-
6	0,21	0,07	40,2	0	-
7	0,44	0,14	65,2	0	-
8	0,17	0,56	50,2	0	-
∑	1,52	1,001			-

Calculated regression coefficients are presented in a table form (Table 21).

Table 15.Regression coefficients

b_0	b_1	b_2	b_3	b_1 b_2	b_1 b_3	b_2 b_3	b_1b_2 b_3
54,52	3,35	-9,07	0,325	1,4	-0,15	-0,075	-0,1

CONCLUSION

1. Analysis of data on Alkali cements obtained on the basis of active mineral substances and applied research showed that on the basis of active mineral mountain ash

available in Uzbekistan it is possible to obtain alkali cement on the account of creation of necessary hydrothermal conditions or high-base additives.

2. It was found out that alkali cements with high physical and mechanical properties can be obtained when replacing active mineral substances in Uzbekistan with tuffite from Navai, which has a high content of antioxidants of high base additives in Portland cement.

3. When Navai tuffite was mixed with water, no activity was observed. Researches have shown that it has the property of porosity when fused with lime and plaster. It became known that such a property of tuffite can be used in obtaining Portland cement with an alkaline active mineral.

4. Addition of Portland cement clinker (up to 70%) or tuffite-based alkaline cement with high alkaline content (3 or 12%) significantly reduces the thickening time. This, in turn, worsens the hydration and hardening conditions of the bonding structure, leading to defective, incomplete and low strength of the cement stone structure.

5. Based on the studies, it was determined that the thickening time of the alkali binder can be reduced to the periods corresponding to the requirements of concrete and reinforced concrete technology when the aqueous solution of the alkali-forming liquid bottle is included in the composition of the binder through active mineral materials.

6. As a result of the research, on the basis of silicate alkali-forming agents, cement corresponding to concrete and reinforced concrete technology of thickening time of M400 or M600 brand was obtained.

7. As a result of the Applied Research, on the basis of non-alkaline-forming, 300 or 400 branded thickening time was obtained portlandcement of alkali-active mineral material of the required level.

8. Developed alkali-active mineral material, the physico-mechanical and technological properties of Portland cement were developed. The results obtained showed that the water requirement of the cement paste of normal thickness of alkaline toffite Portland is slightly lower than the water requirement of the active mineral Portland cement. This is based on the fact that the developed alkali cement has a high strength, is resistant to the effects of cold and aggressive environments.

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