

DEVELOPMENT OF POLYFUNCTIONAL ADDITIVES BASED ON SECONDARY RESOURCES AND TECHNOLOGIES OF PORTLAND CEMENT PRODUCTION

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Abstract: Based on the studies, high fire and heat and weather resistance of cements with the addition of "YuUT-1" were established and appropriate recommendations were given on their use in the manufacture of mortars and concrete. Such a change in the strength of the studied compositions of PCs with blood pressure in time is explained, possibly, by the difference in their mineralogical composition and matrix Portland cement.

Key Words: Portland cement, additive, modifier, heat resistance, technology, strength.

1. INTRODUCTION:

All over the world scientific research is being carried out on the development of composite Portland cement production technology, including the following priority areas: the development of new compositions of composite raw mixtures.

Saving of natural raw materials and the use of secondary raw materials; development of energy-efficient clinker firing technologies; creation a composition of active mineral additives that provide resource-saving technology for the production of Portland cement; development of technologies for the production of new compositions of additive, pozzolanic and colored Portland cement [1].

2. METHOD:

As a result of the studies carried out, the physicochemical bases of cement stone formation have been established; determination of the degree of formation of new minerals during firing of raw mixes with the participation of secondary raw materials; the causes of endo and exoeffects in the process of low-temperature burning of Portland cement clinker have been studied; application of volcanic rocks as active mineral additives in Portland cement production is proposed.

At the same time, research work is also under way to develop new compositions of composite additives based on various types of secondary raw materials; on the production of clinkers based on steelmaking slags and waste from the mining and processing industry; the study of the physic mechanical and technological properties of additive cements; studying the structure of nan cements for concrete gas; reducing the cost of low-energy clinkers and cements; the development of energy and resource-saving technologies for composite cements [2].

In this context, the range of our scientific research covers a wide range of studies on the formation of compositions of a wide range of composite additives with the participation of various mineral ingredients and the additives of the mechanic chemically activated mixture "ash slag of Novo-Anger TPP phosphogypsum" ("YuUT-1"), selection of optimal compositions of composite additives based on various traditionally used mineral additives with the participation of additive YuUT-1" [3].

3. DISCUSSION:

This article presents the results of research on the development and use of composite additives as additives to Portland cement, including "YuUT-1+gliezh", "curative dust+YuUT-1", "gliezh+curative dust+YuUT-1", "gliezh+diabase+YuUT-1".

It is established that the techno genic formations in the form of the massif Kuytash located in the territory of Navoi mining and smelting plant on appearance and the chemical composition (SiO₂ - 55.55% and Al₂O₃ - 13.34%) can be attributed to a clay-like rock, the hydraulic activity of which by student criterion was $t = 33.8$, which is more than its regulated by ND value of 2.07. The SO₃ content in composite additives ranges from 3.77% to 8.06%, which indicates the possibility of their use for producing experimental Portland cement with composite additives without the use of gypsum. Further studies on the preparation of Portland cement with activated additives were carried out using additives

AD3, AD4 and AD5, for the preparation of which the clinker of Kyzylkum cement JSC was used as a matrix. It was found that the introduction of 15 and 20% blood pressure accelerates the process of grinding the mixture to obtain composite Portland cement. This explains the decrease in the proportion of solid clinker component in Portland cement due to its replacement with the dispersed composite additive "YuUT-1 + glielzh". Depending on the amount of composite additive introduced into the cement, the SO₃ content ranges from 1.52 to 2.07%.

4. ANALYSIS:

The physic mechanical characteristics of Portland cement with a mechanochemical activated additive "YuUT-1 + glielzh" are given in Table 1.

Strength indices of CP with KD "YuUT-1- glielzh"

Table 1

Symbol	W/C solution of composition 1:3	Cone spreading, mm	Ultimate strength, MPa, bending and age compression				Cement grade
			7 d		28 d		
			R _{bend}	R _{comp}	R _{bend}	R _{comp}	
ПЦ-Д0	0,384	115	5,3	24,8	6,1	39,80	400
ПЦ АД3-20	0,376	113	5,4	29,4	6,2	40,2	400
ПЦ АД4-15	0,376	115	5,0	24,8	5,7	39,4	400
ПЦ АД4-20	0,376	114	5,7	26,9	6,2	42,6	400
ПЦ АД5-15	0,384	115	5,5	29,4	6,2	44,6	400
ПЦ АД5-20	0,380	115	5,5	21,4	6,2	44,6	400

It has been established that PCs with composite additives are characterized by setting times, values (beginning - from 3 h 35 min to 5 h 15 min, end - from 5 h 15 min to 7 h 10 min.) of which meet the requirements (GOST) O 'z DSt 2830:2014, item 5.1.5.

Thus, the possibility of using the mechano-chemical activated additives " YuUT-1 " and glielzh with a ratio of 60 ÷ 80 mass. % and 40 ÷ 20 mass. %, respectively, as a composite additive in the production of general-building cements PC 400-AD20 without the use of gypsum stone with preservation of their green strength has been established. According to the values of hydraulic activity, all experimental PC with "YuUT-1" additives, despite the reduction of clinker component from 15 to 20%, and with 100% saving of natural gypsum stone, provide grade 400 according to (GOST) - O 'z DSt 2830:2014.

The strength of CP with AD containing "YuUT-1" increases unevenly. In the initial stages of hardening, the increase in the strength of experimental PC occurs rather intensively, by 7 days (60-73)% of brand strength.

In the future, the hardening process slows down and by 28 days the Portland cements studied increase their strength indicators by (27-40)%, while gaining the 100% of mark strength, i.e. the brand 400 . In the period from 28 days to 90 days of hardening, there is a slight decrease in strength indicators of both PC-D0 and PC with AD, which amounted to (6-28)% of the brand strength, which is possibly associated with recrystallization of hydrated neoplasms arising in the process of hydrolysis and hydration of clinker minerals and their transition from one form to another, as well as their interaction with the constituent oxides of mechano-chemically activated additives.. In further terms, the process of chemical interaction and hardening in the system "ground clinker - mechano-chemical activated additive" continues smoothly, by the age of 180 days hydrated products formed in the reaction medium, compacting, strengthen the cement composite, as a result of which the strength of the artificial conglomerate is 11-13% higher than the design values of their mark strength. This change in the strength of the examined SC compositions with AD over time is possibly due to the difference between their mineralogical composition and the matrix SC. However, the difference is that the strength of the stone on the basis of PC-D0 is always lower than that of the PC with the new AD "YuUT-1 + glielzh." The cement composition of AD5-20 PC, obtained by joint grinding of Portland cement clinker and 20% of YuUT + glielzh additive, obtained by mixing 80% of YuUT-1 and 20% glielzh, is optimal.

5. RESULT:

According to x-ray phase analysis, during the hardening of this composition of the PC with AD "YuUT-1 + glielzh", the hydration process proceeds in the same way as when the CP with 20% additive is solidified only "YuUT-1," as evidenced by a sharp decrease in the intensity of diffraction reflections of clinker silicate minerals at d/n = (0.274; 0,262; 0,258; 0,216; 0,194; 0,174; 0,161; 0,153; 0,143) nm. The Ca (OH) 2 line with d / n = 0.242, which has a small intensity, which appeared on the X-ray of a PC with AD that hardened for 1 day, decreases in intensity over time and almost disappears by 28 days, what can we say about its active interaction with AD "YuUT-1 + glielzh" with the formation of 3CaO · Al₂O₃ · 3CaSO₄ · 31-32H₂O, the line of which is detected at d / n = 0.478 nm.

The study of physical and mechanical properties of fine-grained concrete at PC400 – AD20 showed that its average density is 2265 kg/m³, water absorption - 3.62%, and the compressive strength at 28 d is 231 MPa (196.5 MPa for ND) . The quality indicators of fine-grained concrete on cement grade PC400 – AD20 with KD "YuUT-1 + gliezh" in 28 days. hardening at a temperature of (20 ± 2) ° C and relative humidity (95 ± 5)%, satisfy the requirements of ND for the quality of fine-grained concrete of class compressive strength B15 (M 200). Fine-grained concrete of strength class B15 (M200) based on PC 400 – KD20 containing AD "YUUT-1 + gliezh", after 50 cycles of freezing and thawing, showed a strength of 22.48 MPa, which is more than 18.70 MPa of the strength of control samples stored in water, which indicates the high frost resistance of the developed cements with YuUT-1 + gliezh. The resistance coefficient of fine-grained concrete after 25 cycles of alternate wetting and drying amounted to 1.18, while the absence of a decrease in strength indicates its sufficient resistance to climatic fluctuations.

The material composition of the blends for the production of PCs with mechano-chemically activated additives of the specified composition are shown in table 2.

Material composition of mixtures for production of CP with mechano-chemically activated additives

Table 2

* Symbol of cements	Raw material charge composition,% by weight					Σ SO ₃ , %
	Clinker	Plaster stone	YuUT-1	Baking fervor	crushed stone	
PC-D0	95	5	-	-	-	2,930
PC-ADSH -5	80	-	15	5	-	3,500
PC-ADSH-10	80	-	10	10	-	2,752
PC-ADB -5	80	-	15	-	5	3,447
PC-ADB -10	80	-	10	-	10	2,610

6. CONCLUSION:

According to the table, it can be seen that the time of cement setting PC-ADSH-5, PC-ADB-5, PC-ADB-10 do not meet the requirements of the ND. In this regard, for studying of physicomaterial properties the structure of PC-ADSH-10 (structure No. 3) which durability in 28 days of normal curing is 6-7% lower (40.3 MPa), than at PC-D0 (43.3 MPa) is chosen. On the basis of the issued recommendations, Kyzylkumcement JSC has established serial production of PC400-AD20 by replacing 20% of high-temperature clinker component in cement with a composite additive including 10% of " YuUT-1 " and 10% of filling dust.

Thus, mechano-chemically activated additives for cement have been developed with the optimal combination and ratio of components: "diabases of YuUT-1 potash dust" and "gliege of YuUT-1 diabases," the introduction of which into cement provides 20-30% replacement of clinker and obtain heat-resistant Portland seeds of grades PC400-D20, PC 400-AD30 and PC 300-AD30.

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