ENERGY AND RESOURCE SAVING "GREEN TECHNOLOGY" FOR PRODUCING A NEW TYPE OF PUZZOLAN CEMENT[1]

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Annotation. The article presents the results of research on the production of pozzolanic cements with the maximum use of ash and slag mixtures of dry removal of the Angren TPP as an additive.
Keywords: ash-and-slag mixture from TPP, dry disposal, disposal, addition to cement, Portland cement clinker, joint grinding, pozzolanic cement, strength, structure, environmental and economic efficiency.

In the Republic of Uzbekistan, the problem of ecology is being solved at the state level, in connection with which consistent work is being carried out in the field of ensuring environmental protection, rational use of natural resources, improving the sanitary and ecological situation. To achieve the National Sustainable Development Goals and Targets for the period up to 2030,The concept of environmental protection of the Republic of Uzbekistan establishes all aspects of maintaining the ecological balance in the republic, from "improving the environmentally safe waste management system" to "economic stimulation of the development and implementation of waste-free and low-waste technologies in production, as well as technologies for the processing of mining and processing waste. productions " [one].

In the sludge dumps of TPPs, a huge amount of ash waste from hydraulic removal is accumulated, which has a negative impact on the environmental situation, and low hydraulic activity inhibits their large-scale utilization in the production of construction products of a wide range [2].

Therefore, preference is given to the dry method of removing them from the furnaces of coal-fired boilers. This method increases the degree of their useful consumption by developing resource-saving and environmentally friendly technologies for the production of construction products, in particular, cement. In this regard, in 2016, the Chinese company Harbin Electric International

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Company Ltd on the basis of the Angren TPP modernized and put into operation one power unit for dry ash disposal.The power unit will annually generate 1,050 million kilowatt-hours of electricity and 642.2 thousand Gcal of thermal electricity. [3]. A new power unit with a capacity of 130-150 megawatts with a cogeneration extraction for burning high-ash coal was put into operation and put under load, in connection with which there was a problem of utilization of dry ash-and-slag mixture removal (hereinafter referred to as AZShS). Earlier, in the research and testing laboratory "Strom", comprehensive studies were carried out to determine the hydraulic activity and suitability for use as an additive in cement. Taking into account the rather high hydraulic activity of the dry ash-and-slag mixture (the value of Student's criterion t = 52.59), the organization standard TS 18388312-01: 2019 “Activated ash-and-slag mixture. Technical conditions ", a technology for the production of Portland cement for general construction purposes has been developed, containing up to 20% of granulated dry ash and slag mixture, the ecological, technological and economic efficiency of using the active dry ash and slag mixture (hereinafter ASHS) of Angren TPP as an active mineral additive in cement[4-6]. At the same time, a significant margin of strength indicators of modified Portland cement predicts the possibility of introducing AZShS during grinding
clinker, which prompted us to continue research in terms of direction. Portland cement clinker of Akhangarantsementnt JSC, gypsum from the Bukhara deposit and an averaged sample of dry removal AZShS at Angren TPP, the chemical compositions of which are presented in Table 1, were used as starting materials.

Table 1 - Chemical composition of clinker and gypsum stone

Component name	Mass content of oxides,%							
	p.p.	SiO2	Al2O3	Fe2O3	CaO	MgO	SO3	Other
Clinker JSC "Akhangarancement"	0.36	21.30	4.75	4.86	63.58	3.07	0.36	1.58
	Mineralogical composition and modular characteristics							
	C3S-59.09; C2S-16.49; C3A-4.34; C4AF-14.77; KH-0.91; n 2.22; p-0.98							
AZShS Angren TPP	0.61	64.79	20.64	3.99	3.36	0.80	1.64	4.12
Gypsum stone	At 4000C 19.57	8.76	1.82	-	28.58	-	42.77	2.41

For researchInfluence of AZShS on the physical and mechanical properties of Portland cements in terms of their hydraulic activity in laboratory conditions from cement paste with different content of AZShS small samples-cubes with a size of (2x2x2) cm with a composition of 1: 0 were made. As an object of comparison, no additive Portland cement was prepared, obtained by joint grinding of 95% clinker and 5% gypsum stone. The material compositions of the mixtures and the strength indicators of Portland cements modified with a high content of AZShS are shown in Table 2.

Table 2 - Influence of dry ash and slag mixture on the physical and mechanical properties of Portland cement

No.	Composition and designation of cements, wt%				Compressive strength, MPa, after (day) hardening				
	Designation	Clinker	Gypsum	AZShS	one	3	7	28	90
one	PC-D0	95	five	-	10.3	33.4	41.0	42.5	46.8
2	PC-D30	65	five	thirty	8.7	24.5	34.5	52.5	54.3
3	PC-D40	55	five	40	10.0	25.0	35.0	55.5	47.5
four	PC-D50	45	five	fifty	8.7	23.0	34.5	47.5	45.8
five	PC-D60	35	five	60	8.8	15.0	30.0	38.1	38,7

In accordance with the data in Table 2, the introduction of (30-40)% has a slowing down effect on the formation of the strength of the cement stone, as a result, its strength indicators are up to 7 days lower than that of PC-D0. However, in the future, the hardening process of these compositions of modified cements is accelerated and the strength indicators of stone based on them by 28 days are (10.0-13.0) MPa higher than that of PC-D0.

Specimens of highly filled cements containing (50-60)% of the addition of dry ash and slag mixture in the first (1-7) days are characterized by the same strength indicators as cements with (30-40) AZShS. In the future, their strength indicators have higher values, which for cement samples with 50% of concrete samples based on test cement PC400-ZD20 have maximum resistance to alternating wetting and drying in comparison with samples made of concrete based on PC 400-D0 cement. So, the coefficient of weather resistance of samples made of concrete O-No. 2, after 25 cycles of alternating moistening and drying was K_{atm}= 1.04, and the coefficient of weather resistance of concrete specimens O-No.1 - Catm = 0.91. The least resistance to natural influences is possessed by samples of concrete O-No.3, the strength loss of which amounted to 17.4%, and Catm = 0.83. Compared with the permissible value of indirect estimation losses (no more than 20 to 25%), all samples of concretes of optimal compositions withstood weather resistance tests: their strength indicators by 28 days are slightly higher than the strength of PC-D0, and for specimens made of highly filled cement with 60% AZShS - lower than that of it.

Based on the obtained research results, it was concluded that the higher the content of AZShS in the cement, the slower the strength of the stone based on it is gaining. At the same time, the

degree of filling of the cement should not exceed 50%, otherwise the hydraulic activity of the cement stone will not provide its grade at the level of the base Portland cement.

Due to the fact that concrete during operation is exposed to various kinds of environmental influences (alternating drying and moistening, alternating freezing and thawing, etc.). The resistance of cement to various kinds of influences largely determines the durability of concrete made from it. One of the main methods for testing cement related to determining its resistance are weather resistance and frost resistance. The study of the resistance of cements with the addition of AZShS to various environmental influences was carried out on standard samples (70 × 70 × 70) mm, made of concrete of class B 15 (M200) in compressive strength. Experimental Portland cement containing 40% AZShS with the symbol PCZ-D40, characterized by a hydraulic activity of R28 = 465 kgf / cm2, was used as binders for the preparation of concrete. For comparative tests - Portland cement without PC-D0 additive (R28 = 418kgf / cm2). Crushed stone from gravel of a mixture of fractions from 5 to 20 mm was used as a coarse aggregate. The study of the resistance of cements with the addition of active ash and slag mixtures to various environmental influences was carried out on standard specimens (70 × 70 × 70) mm made of concrete of class B 15 (M200) in compressive strength. For further tests, concrete compositions were taken based on cements of control cement PC 400-D0 and test cement PC 400-ZD40 of the following optimal compositions with a cement consumption: 298 kg per 1m3 - for the control composition of concrete from PC400-D0 (O-No.1) and The study of the resistance of cements with the addition of active ash and slag mixtures to various environmental influences was carried out on standard specimens (70 × 70 × 70) mm made of concrete of class B 15 (M200) in compressive strength. For further tests, concrete compositions were taken based on cements of control cement PC 400-D0 and test cement PC 400-ZD40 of the following optimal compositions with a cement consumption: 298 kg per 1m3 - for the control composition of concrete from PC400-D0 (O-No.1) and The study of the resistance of cements with the addition of active ash-and-slag mixtures to various environmental influences was carried out on standard specimens (70 × 70 × 70) mm made of concrete of class B 15 (M200) in compressive strength. For further tests, concrete compositions based on cements of control cement PC 400-D0 and experimental cement PC 400-ZD40 of the following optimal compositions with a cement consumption were taken: 298 kg per 1m3 - for the control composition of concrete from PC400-D0 (O-No.1) and
297 kg per 1m3. - for the optimal composition of concrete from cement with 40% AZShS (O-No.2).

When testing concrete samples, the following methods were used: determination of the ultimate compressive strength of concrete samples at the age of 28 days, 3, 6 months, 1 year, according to GOST 10180-2012 “Concrete. Method for determining strength by control samples "; frost resistance - according to GOST 10060-2012 “Concrete. Methods for determining frost resistance "; weather resistance - according to the accelerated method of the Central Scientific Research Laboratory of the Glavkievstroy.

The test results showed that concretes made from cements containing 40% AZShS as an additive have a sufficiently high frost resistance, they withstood 25 cycles of alternate freezing and thawing, which corresponds to their frost resistance brand F125. A decrease in the strength of the samples has not been established, moreover, after 25 cycles of thermal cycles, their strength even increased slightly and the values of the frost resistance coefficient (KCmrz) were: for concrete O-No.1 = 1.066, and for concrete O-No.2 = 1.089.

The study of the weather resistance of Portland cements with AZShS was carried out on samples made of concrete O-No.2 and for comparative tests - from concrete O-No.1. Multiple alternating moistening and drying, causing a decrease in the strength (up to 20%) of concrete specimens, was used as an indirect method for assessing their resistance to fluctuations in atmospheric conditions. specimens made of concrete based on test cement have maximum resistance to alternating wetting and drying in comparison with specimens made of concrete based on PC 400-D0 cement. So, the coefficient of weather resistance of specimens from concrete O-No.2 after 25 cycles of alternating moistening and drying was Katm = 1.04, and for specimens from concrete O-No.1 - Katm = 0.91. Consequently, specimens of concretes based on Portland cement modified with 40% AZShS successfully passed the weather resistance tests.

The positive results of the research served as the basis for the industrial development of the technology of Portland cements with a high degree of filling with an activated ash-and-slag mixture of dry removal. At present, the technology of obtaining Portland cement grades "400" and "500", containing (40-45)% AZShS, has been implemented at LLC FE "BAZIS".

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