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Definition Of Puzzolanic Properties Active Mineral Additives In Portlandcement

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ABSTRACT

The article presents the results of testing the use of Angren dry remote active ash and slag in Portland cement as an active mineral additive. It was found that Portland cement with the addition of Angren dry remote active ash and slag renders karrazastoy, ekanomet clinker and it is proved that hydro removed ash and slag (2011 year) does not recommend as an active mineral additive. Therefore, dry remote active ash and slag is recommended for use as an active mineral additive in the production of cement, improving its construction and technical properties. The possibility of using Angren dry remote active ash and slag as an active mineral component for producing cements with low corrosion resistance is shown. Angren dry remote active ash and slag contributes to the formation of the structure of the cement stone, increases its density and strength against aggressive ions, causing increased resistance in aggressive environments. And save up to 30% of cement. It has been established that Portland cement with the addition of Angren dry remote active ash and slag has an intensifying effect on the formation of clinker minerals. Therefore, the Angren dry remote active ash and slag is recommended for use as a mineralizing additive in the production of cement. Use of chemical industry waste with replacement of expensive natural production and consumption waste. At the same time, an environmental problem is being addressed.

KEYWORDS

Hydraulic additive, swelling, Portland cement, clinker, lime, dry remote active ash and slag, hydro removed ash and slag, aluminum hydroxide, iron hydroxide, calcium hydro-silicate, pozzolan, mineral additives, sulfate resistance, water resistance, hydration, leaching.

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INTRODUCTION

Active mineral additives with pozzolanic properties have been used for many decades to improve the physical and mechanical properties of the resulting materials based on Portland cement, increase their durability, and chemical resistance [1-3]. Like any other acidic silica-alumina additive, when added to Portland cement, it improves a number of its technical properties, such as water resistance and sulfate resistance, and reduces exo-therm. In this case, the main advantage of such a material is the ability to bind calcium hydroxide formed during the hydration of Portland cement minerals in the presence of water at ordinary temperatures and thereby prevent $Ca(OH)_2$ leaching. When it interacts with an active mineral additive, the so-called pozzolanic reaction occurs, as a result of which the content of calcium hydro-silicates increases [4-7]:

$$SiO_2+Ca(OH)_2+nH_2O= CaO \cdot SiO \cdot nH_2O.$$

It is known that hydraulic additives, by absorbing lime, reduce its concentration in the liquid phase of the hardening cement. In this case, the active silica of the additives forms with the hydrate of calcium oxide calcium hydrosilicates of the tobermorite group, which increase the density and salt resistance of the cement stone; active alumina — gives calcium hydroaluminates, which, under predetermined conditions, can adversely affect the sulfate resistance of cement [8-12].

THE MAIN FINDINGS AND RESULTS

In this part of the work, the results of the study of pozzolanic properties of Angren dry remote active ash and hydro removed ash and slag (2011 year) and clinker (JSC "Bekabodcement") used at cement plants in Uzbekistan or are of practical interest from this point of view are given.

To characterize these additives in table 1, 3, we give the chemical composition and their activity, determined in accordance with IS (Interstate standard) 6162.

MATERIALS RESEARCH METHODS

Method 1. The products of the interaction of active additives with lime were studied by us on samples aged for 30 days in a saturated solution of lime. In decreasing order of activity (the amount of mg CaO absorbed by 1 g of the additive in 15 titrations [13, 14, 15]). Are given in table-2. To carry out these experiments, solutions of calcium oxide hydrate containing 1.1 g CaO in 1 liter were taken.

Table 1

The chemical composition of the starting materials

Supplement type	Content of mass fraction of oxides,%							
	P.p.s	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	Rest
Dry remote active ash and slag	0,93	59,76	26,44	3,2	3,64	1,81	0,68	3,54
Hydro removed ash and slag (2011 year)	9,25	49,60	16,92	4,78	15,64	1,40	1,70	0,71
Clinker	0,75	20,54	5,19	3,56	62,04	3,60	0,62	4,24
Gypsum stone	At 400 °C 19,10	1,52	0,13	0,14	33,04	0,20	43,46	2,41

Table 2

Activity of hydraulic additives

Active additive	Activity according to IS 6269 - 63, mg CaO per 1 g of additive, not less	Activity, additives for the absorption of lime from a lime solution within 30 days. In mg CaO per 1 g of supplement	Swelling 2 - g of the additive.
Dry remote active ash and slag	50	121	52
Hydro removed ash and slag (2011 year)	50	53.27	32

Method 2. Angren dry remote active ash and hydro removed ash and slag (2011 valid) activity was determined according to IS 25592-2019. Given in table-2. To carry out these experiments, solutions of calcium oxide hydrate were taken containing more than 1.15 g of CaO in 1 liter.

From the prepared sample, the crushed and dried Angren dry remote active ash and hydro removed ash and slag (2011 year) were weighed on an analytical balance a sample weighing 1 g. The vessel was tightly closed with a lid and kept at a temperature from 85 °C to 90 °C for 8 h.

Method 3. The pozzolanic activity of the additives under study was studied according to the method "Method for determining the degree of saturation with lime of the liquid phase in contact with cement" [13, 15], which is based on the ability of mineral additives to absorb lime (CaO) formed as a result of hydration and hardening of cement based on clinker, additives and gypsum.

Table-3

The activity of hydraulic additives in accordance with IS 25592-2019

Active additive	Activity according to IS 25592-2019, mg CaO per 1 g of additive	Activity, additives for the absorption of lime from a lime solution within 8 hours. (80-90 °C) In mg CaO per 1 g of additive	Swelling 1 - g of the additive.
Dry remote active ash and slag	high: more than 70 medium: 30 to 70 low: less than 30	34.7	-
Hydro removed ash and slag (2011 year)		3.37	-

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The results of tests to determine the hydraulic activity of the additive in the composition of cements and non-additive cement D-0 No. 1Ts, No. 2Ts, No. 3Ts are shown in Table 4.

Table-4

Hydraulic activity of additives, determined by the method of saturation of the liquid phase with lime in contact with cement

№/№	Active mineral supplement		CaO content in liquid,%	Total alkalinity of the solution, meq / l
	Name	Type and origin		
№ 1ts	Dry remote active ash and slag	Fuel ash and slag	3,3	51,60
№ 2ts	D-0	-	4,2	68,00
№ 3ts	Hydro removed ash and slag (2011 year)	Fuel ash and slag	4,2	104,00

According to the test procedure used, the data were processed according to the graph built in the coordinate system: total alkalinity of the solution in meq / l - lime content (CaO) in% (Fig. 1).

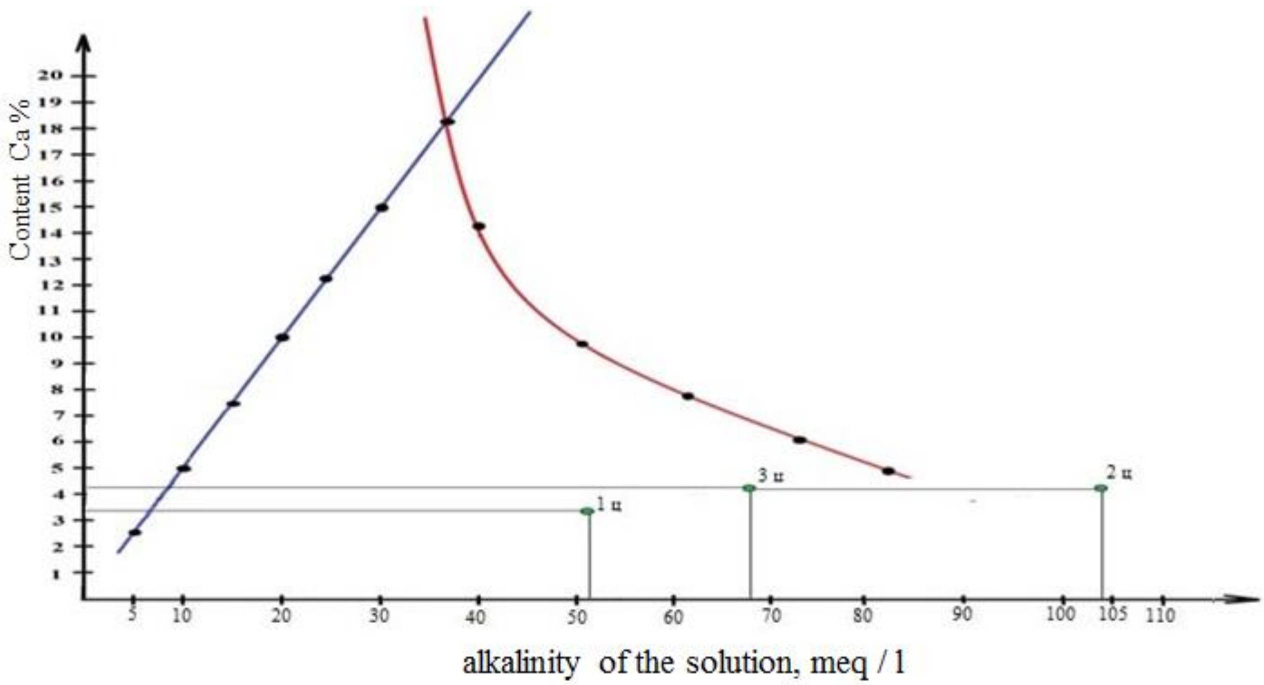

Fig 1. The degree of pozzolanic activity of mineral additives

A. Alkalinity attributable to all components except lime

B. Isotherm of lime solubility at 400

1c - CaO content in cement slurry with the addition of Dry remote active ash and slag

2c-content D-0

3ts - CaO content in cement slurry with the addition of Hydro-removed ash and slag (2011 year).

In accordance with the data in Table 4, a point is plotted on the graph (Figure 1) corresponding to the lime content (CaO) at the obtained alkalinity in each cement slurry No. 1C. Depending on the location of points 1 (Dry remote active ash and slag) in relation to the solubility isotherm (curve 2) of lime, the quality of the additive is qualified. An additive is considered to be active if it provides in the liquid phase in contact with cement prepared on its basis, the lime content is below the saturation state. As can be seen from the location on the graph of points 1, Dry remote active ash and slag have the ability to absorb CaO released during the hydration and hardening of solutions based on cements No. 1C. As can be seen from the location on the graph of points 3 of the Hydro-remote ash and slag (2011 year) does not absorb CaO, but it sees the OH^- ion. So INTO Hydro removed ash and slag (2011 year) is not recommended to add cement.

CONCLUSION

1. During the interaction of active silica and alumina, as well as the vitreous phase of active additives with calcium oxide hydrate, calcium hydro-silicates of the tobermorite group and calcium hydro-aluminate of the C_4AH_{13} type are formed, which confirms the conclusions of other researchers.
2. The content of free hydrate of calcium oxide in hardening pozzolanic Portland cement depends on the activity of the additive, determined according to GOST 6269-63. Intensively bind lime with medium active. Dry remote active ash and slag, weakly inactive Hydro removed ash and slag.
3. In Figures 1 it can be seen that Dry Remote Active Ash and Slag is recommended as a pozzolanic additive for cement. Hydro removed ash and slag (2011 year) is not recommended to add cement.
4. From swelling and activity can be seen Dry removed active ash and slag will make the cement corrosion resistant.

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