ALKALI-ACTIVATED CEMENTS BASED ON RAW MATERIALS FROM CENTRAL ASIA

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ABSTRACT:

The complex physic-chemical methods for studies of established products studied alkali cement hardening, which is represented low basically hydro-silicate calcium, xonotlite, tobermorit, calcite and alkali hydro alumina silicates. This composition of tumors causes high physic mechanical and technological properties and durability of alkali cements developed on the basis of active minerals from which significantly expanded resource base alkali cements.

Keywords: alkali-activated cement, tuffite, alkaline component, slag, clinker, strength, setting time.

INTRODUCTION:

Scientific and technical progress in the construction of industry includes the development and production of binders with special properties. Such materials include alkali cements based on alkali metal compounds, developed in the fifties of last century,

Professor V.D.Glukhovsky and these are now active alkalization. These cements are characterized bylaw-cost heat and electricity in their production, high physical and mechanical properties, durability. It is caused by tumors, creating structural links in the hardened artificial stone on the basis of alkaline binders.

Principles of regulation properties of the final product by direct synthesis of neo plasmas in the hardening of alkaline stone, designed by Professor P.V.Krivenko it possible to create alkaline binders with a given phase composition of building blocks, providing predictable properties, regardless of the chemical and mineralogical composition of the silicate component.

One way to control the properties of proposed changes in acid-base balance of the introduction of highly basic astringent additives, in particular Portland cement, calcium oxide [1]. Analysis of studies in this field indicates the presence of vast potential energy of the "alkali-highly basic slag additive", the realization of which will provide high-strength cements. However, the introduction of highly basic additives leads to a drastic reduction in terms of setting and the problem is solved in these papers, the introduction of chemically pure product, potassium fluoride, which increase the cost of material and greatly complicate the process of cement production.

Resources base of alkaline binders in Uzbekistan is immense, which differs in chemical and mineralogical composition and properties. Scientists of Uzbekistan on the basis of a number of active alkaline mineral binders developed low marks, which are introduced for highly basic additives, dramatically reducing setting time [2]. In accordance with the purpose of this paper is to develop ways of setting maturities alkali cements based on local active minerals in the presence of highly basic additives and obtaining high alkaline slag Portland cement and pozzolanic.

RAW MATERIALS AND RESEARCH METHODS:

In studies with the aim of obtaining alkali binders we used tuffite Navoi career, which is currently used as an additive in the manufacture of hydraulic Portland cement plant in Navoi and deposits of which are huge. The analysis showed tuffites fairly stable chemical composition (Table 1). This table shows the chemical composition of Portland cement clinker "Kyzylkumcement". Saturation coefficient was 0.90. The mineralogical composition of clinker: C_3S = 58%, C_2S = 18,8%, C_3A = 6.3%, C_4AF= 1.4%.

In order to establish the hydraulic activity of the samples were prepared tuffites 40x40x160 mm size of the normal density test binder consisting of 80% tuffites, 20% lime and 3% above dimorph's gypsum. Samples, of the steam thoroughly in a steam chamber at 85+5°C for 6 hours. Test results showed that the mean value of compressive

Table 1 Chemical composition of raw materials

Name of raw materials	Weight content of basic oxides and moisture content,%								
	Loss on ig-nition	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	SO_3	R_2O	Total
Tuffite	16,91	5014	8,74	2,80	11,38	2,62	4,23	3,61	100,43
Portland clinker	0,30	2184	4,78	3,75	64,79	2,59	0,33	1,47	99,82

strength was 8.2 and at a bend - 0.11 MPa, which indicate the presence of hydraulic activity tuffites.

In the present study as calcium alumina silicate component was also used electro thermo phosphorus slag Chimkent JSC "Phosphorus", containing the mass. %: SiO_2 -41,24, Al_2O_3 - 2.72, Fe_2O_3 -0.45, CaO-44.87, MgO-5.00, SO_3- 0.83 c base city of 1.13 and unit activity of 0.07.

In an alkaline component used high modulus commercial water glass with silicate modulus 1, 2, 3 and a density of 1300 kg/m^3. Specific surface binding was monitored by the instrument and PSC-2 was 300-310 m^2/kg. As the fine aggregate used enriched Zarafshan river sand quarry with Mk=2,1...2,3, satisfying the requirements of GOST 8269-93. When, the testing the binders used sand that meets the requirements of GOST 6139-2003. Tests of binding were conducted in accordance with GOST 310.1...310.3.-76, GOST 310.4-81. For special studies were made with samples of bricks-edge 20 mm from the normal density test. Heat and processing of samples was carried out in mode 3+6+2 h at 90-95°C isothermal holding.

The studies used tuffites-clinker and slag-clinker mixtures containing them in Portland cement clinker from 30 to 70%, and shuts solution of potassium silicate liquid glass with a module (M_C) 1, 2 and 3. The microstructure of binders was studied by an electron microscope TELSA-BS-242E.

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RESULTS AND DISCUSSION:

As follows from the data, the introduction of the pozzolan and Portland slag cement alkali greatly reduces the setting time, which affects the conditions of hydration and hardening of the composition contributes to the formation of defective, inadequate structure of cement stone and results in low mechanical strength of the latter.

This phenomenon can be explained as follows. As is known [3], the hydration of alkali alumina silicate cements based on the type of slag with a high content of calcium action exchange process occurs between the component and an alkaline silica-alumina, the result is a hydrous calcium low basically and caustic alkali. Next, caustic alkali continues to interact with alumina silicate glass phase up until all the calcium does not go into low basically hydrated. At the end, of the hydration of alkali, joining with the remaining alumina silicate to form sodium (potassium) hydro alumina silicates such as zealots.

In the case of a silica-alumina component tuffites lower concentration of calcium oxide (not more than 12%), tumor type low basically hydro silicate calcium formed in small quantities, do not grip the entire system hardening. Seizure does not occur.

It is also known, which is associated with Portland cement setting the hydration of tri calcium acuminate. However, this process can cause a sharp reduction in setting time of the system with a high content of highly basic Portland cement clinker. Apparently, the reason is the presence of Portland cement clinker and a large number of tri calcium silicates, di calcium that in strongly alkaline medium to actively take cat ion alternative process quickly is the process of coagulation, mainly on the surface of the binder. Catching up is quick. Consequently, we can assume that delaying the time of interaction with highly basic alkaline components of Portland cement clinker minerals can be extended setting time.

In this regard, we were invited to enter into an alkaline component astringent composition through active mineral component, pre-impregnated with liquid glass. Preparation of the binder was carried out co-fine grinding of the active mineral component, pre-impregnated with liquid glass density of 1250, 1300 kg/m^3, and Portland cement clinker to the fineness corresponding to the specific surface area of PSC-2 is not less than 300 m^2/kg. Shredded material alumina silicate shuts water. The test results are shown in Table 2.

Table 2 Setting time and strength of slag Portland cement and pozzolanic alkali

Number	Slag/ tuffite, %	Clin-ker, %	Liquid glass		Setting time, h-min		Tensile strength, MPa, compressive strength, after	
			MPa	kg/m^3	start	end	stea-ming	28 days of curing in water
1	70/0	30	1	1250	1-20	2-00	65,0	63,0
2	70/0	30	2	1300	1-10	1-40	66,9	65,2
3	70/0	30	3	1300	0-30	0-50	60,8	60,1
4	100/0	0	1	1250	2-30	3-20	56,1	65,0
5	100/0	0	2	1300	2-20	3-10	58,0	56,5
6	100/0	0	3	1300	2-10	3-00	55,2	56,0
7	30/0	70	1	1250	1-10	2-00	75,0	64,5
8	30/0	70	2	1300	1-00	1-30	81,2	68,0
9	30/0	70	3	1300	0-25	0-40	71,3	62,6
10	50/0	50	1	1250	1-20	2-05	74,0	64,0
11	50/0	50	2	1300	1-10	2-00	75,3	66,0
12	50/0	50	3	1300	0-30	1-10	69,1	61,2
13	0/70	30	1	1250	1-30	2-30	55,2	24,6
14	0/70	30	2	1300	1-20	2-00	58,0	25,9
15	0/70	30	3	1300	0-45	1-22	52,3	23,8
16	0/30	70	1	1250	1-18	2-21	64,0	40,2
17	0/30	70	2	1300	1-10	1-50	65,7	41,2
18	0/30	70	3	1300	0-38	0-20	60,9	36,0
19	0/50	50	1	1250	1-22	2-25	59,3	35,0
20	0/50	50	2	1300	1-15	1-55	60,2	35,5
21	0/50	50	3	1300	0-42	1-20	56,5	32,1

Note: The water glass was introduced by impregnation of slag or tuffites.

From table 2 that the proposed method of introducing liquid glass allows for 20...30 minutes lengthened initial set of alkaline slag Portland cement and pozzolanic. Increased content of clinker astringent compositions accelerates its grasp. Reduction of silica modulus and density of a solution of sodium silicate slow setting cement paste.

This phenomenon can be explained by the fact that in the process of hardening are active in the mineral component of the liquid glass over time, gradually passes into solution and creates a highly alkaline environment necessary for the processes of hydration of the binder. Thus, studies have established that the introduction of the alkali silicate component in an active mineral component will extend the setting time of alkali slag Portland cement and pozzolanic.

The establishment of the possibility of setting maturities of alkaline slag Portland cement and pozzolanic introduction of alkali impregnation of the active component of the mineral component will go on to develop optimum compositions studied binders. To do this, samples were prepared ravine-size 40x40x160 mm of sand-binders (B: P=1:3) mixture of normal consistency. Part of the samples after 2...4 hours hardening were steaming in mode 3+6+2 hours at 85...90 0C and then tested for bending and compression. Another part of the daily samples after hardening in the form of hardening of the daily and 27 in water were tested in bending and compression. The test results are shown in Table 2, which shows that the proposed route of administration of soluble alkali silicate component allows you to alkaline slag Portland cement and pozzolanic high (up to M800) brands. Also found that the strength of the steamed samples is higher than tverdevshih in the water. Probably, when steaming processes of transition of alkali component in solution and binding is strongly accelerated.

Increasing the number of Portland cement resulted in a slight increase in strength, hence the optimal composition may contain 30...50% of Portland cement clinker. Studies of the effect on strength properties of alkali-slag Portland cement and pozzolanic modulus liquid glass showed that the greatest strength is observed in the case of disilicate.

Thus, studies were obtained and alkali pozzolanic slag Portland cement-based silicate of alkali metal salts of high grades M400…M800 with acceptable setting time in the

technology of concrete and reinforced concrete.

The proposed method of introducing is an alkali component in the case of the soda or soda alkalinity melt can lengthen the initial set of alkaline slag Portland cement and pozzolanic. However, the effect of extending the proposed method is pronounced in the case of liquid glass than non silicate alkaline components (Table 3).

Analysis of the results indicates that the proposed method allows to obtain alkali cements M300...M600 on the basis of non-silicate alkali metal. In this case, the activity of alkaline cements studied compounds depends on the type of alumina silicate component and curing conditions. With the increase in the basicity modulus, alumino- silicate component strength of binding increases.

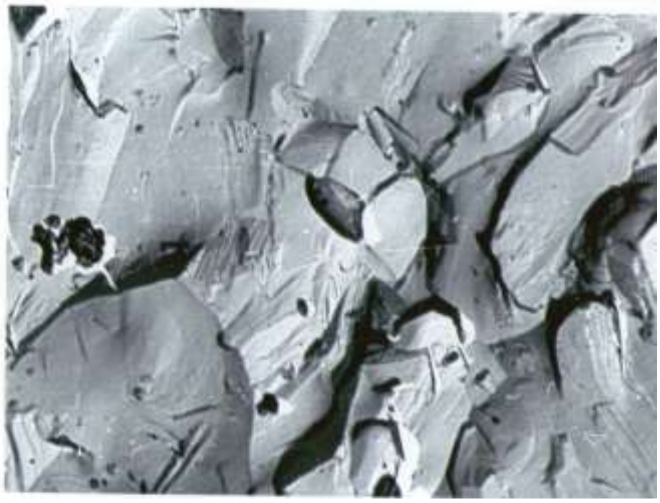
Thus, the strength of the alkali cements on the basis of steamed ash containing additives Portland cement 30, 50 and 70% in the case use as an alumina silicate component tuffites with M_0=0.24 are respectively 33.7, 38.3 and 48.1 MPa in the case of slag with

Table 3 Setting time and strength of slag Portland cement and pozzolanic alkali on the basis of alkali metal salts non-silicate

№	Slag/ tuffite, %	Clin-ker, %	Kind of an alkali compo-nent	Setting time, h-min.		Tensile strength, MPa, compressive strength, after beginning of the end of	
				start	end	stea-ming	28-day solid-denia in the water
1	70/0	30	Soda	0-40	1-10	51,8	42,3
2	70/0	30	SAA	0-50	1-30	46,2	38,1
3	100/0	0	Soda	0-50	2-100	39,1	30,0
4	100/0	0	SAA	2-05	2-20	37,2	28,2
5	30/0	70	Soda	0-20	1-00	61,1	50,0
6	30/0	70	SAA	0-30	1-10	55,2	45,6
7	50/0	50	Soda	0-40	1-15	55,3	45,3
8	50/0	50	SAA	0-50	1-15	51,2	42,2
9	0/70	30	Soda	1-00	2-20	33,7	17,9
10	0/70	30	SAA	1-10	2-30	32,9	17,0
11	0/30	70	Soda	0-40	1-30	48,1	30,2
12	0/30	70	SAA	0-50	1-40	40,8	29,3
13	0/50	50	Soda	1-05	2-20	38,3	26,0
14	0/50	50	SAA	1-10	2-30	35,0	23,1

Note: SAA- soda- alkalinity afloat.

Picture 1. Type of stone of alkaline cement composition "slag + liquid glass" with an increase of 5000 times



Picture 2. Type of stone composition "cement + water" with an increase of 5600 times

M_0=1.13 – is 51.8, 55.3 and 61.1 MPa that more than about 1,3÷1,5 times. A similar pattern is observed for samples hardening in vivo, but the curing of the latter is lower than the steamed samples. This can be explained by the fact that when steaming in the transition of an alkali component alumina silicate component in solution is greatly accelerated.

The introduction of the alkali cements increased amount of Portland cement clinker undoubtedly change to the composition of the tumors. In this regards, studied the composition of products developed by the hardening of alkali binding complex physic-chemical methods of investigation, including microscopy, roentgens and differential thermal analysis (Pictures 1,2). Roentgens diffraction analysis was performed on diffract meter URS-50 IM in the powder method. Recording the diffraction pattern was carried out in the angular range 10-60^0 at a rate of 4^0 circle sample per minute. Explanation of the diffract gram was carried out by the identification data obtained from the characteristics given in the literature.

Derogator grams hydrated binders were taken at the facility by "Pauli" in the largest sample of 500 mg and the values of parts DTG and DTA galvanometers, equal to 1/10. Maximum temperature of the sample is-1000^{0}C. Shooting speed is 10 degrees per minute. As a standard we used calcined technical alumina. In deciphering derogator grams used in [5]. Due to the fact that the best is 30...50% of Portland cement and hardening of the investigated binding proceeds more intensively in the steaming, the study were only samples, the last heat and humidity treatment, and containing 30% Portland cement clinker. Analysis of roentgens and DTA curves showed that the products of alkaline cement hardening prevails gel phase and the crystalline phase is presented in the first place low basically type calcium hydro silicates CSH(B), tobermoritom, ksonotlitom and calcite. Alkaline hydro-alumina-silicates in the initial period of hardening are gel phase. Effects characteristic of calcite, in the case of soda and soda alkalinity melt more pronounced than in the case of liquid glass. On this basis it can be explained by the fact that the setting time using alkaline carbonate components in the study of binding is shorter than with liquid glass. This is due to rapid crystallization of calcite in the early stages of hardening, hardening accelerating seizure test.

CONCLUSIONS:

Thus, the complex physic-chemical methods for studies of established products studied alkali cement hardening, which is represented low basically hydro-silicate calcium, ksonotlitom, tobermoritom, calcite and alkali hydro alumina silicates. This composition of tumors causes high physic mechanical and technological properties and durability of alkali cements developed on the basis of active minerals from which significantly expanded resource base alkali cements.

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