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STRENGTH OF CEMENTS OBTAINED WITH THE ADDITIVE OF PROCESSED MINERALS

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Abstract: the article presents the results of studies of new mineral additives on the strength properties of cements. The proposed mineral additives made it possible to obtain cements without lowering the grade. Modification of additives implies an increase and increase in the starting raw material and its chemical activity. Modified Additives have a positive effect on the properties and strength of cement. Thus, the use of fractional waste from steelmaking (FOSPP) has been established, and heat treatment of kaolin enrichment waste (TOW) as a modification of additives (AM) leads to energy savings for grinding cement and a reduction in the cost of the product. The proposed additive and methods for preparing cement additives open up a wide opportunity for recycling industrial waste in the production of cement, improves the environment in industrial region, and also stabilizes the physical and mechanical properties of cement products.

Key words: cement, mineral additives, clinker, strength.

Introduction: An effective way to reduce the cost of cement and improve its quality is the use of mineral additives. Natural additives have been studied quite fully and their use is often related to the availability of industrial reserves, distance from the cement manufacturer, stability of the chemical composition and properties of the mineral [1, 2].

Modification of natural raw materials and industrial waste is the best way to obtain additives with previously known properties and ensure stability of cement characteristics [3-6].

Methods for modifying additives (AM) can be different: chemical, mechanical activation, thermal, etc. When chemically modifying additives, the unnecessary component of the raw material is removed, i.e. enrichment of raw materials occurs. Mechanical modification implies an increase in the specific surface area of the feedstock, which means an increase in its chemical activity. Thermal modification is the most common method, which allows you to obtain additives with controlled quality indicators. The combination of mechanical activation and thermal modification gives the greatest effect.

Mineral additives most widely used in the cement industry are rocks of natural and artificial origin, consisting of low-basic silicates, calcium aluminates and ferrites, amorphous silica and other substances that have quite noticeable independent hydraulic and pozzolanic activity (t-test or Student's test) . The purpose of using such additives is to replace part of the cement clinker in the cement composition while maintaining or increasing the strength of the cement.

The positive effect of using additives that are inert to water and do not enter into chemical interaction during the process of cement hydration is explained by stimulating the formation of a stable and dense packing of the matrix of the cement hardening system. The most appropriate in this direction may be the use of mineral additives with the smallest particle sizes, for example, the use of microsilica in the composition of cements.

The technical requirements for the production of modified cement additives are well known: specific surface area in the range of 200-500 m2/kg, which is in the range of the specific surface area of cement; amorphous, glassy and partially crystallized structure. The high specific surface area of the additive and cement does not exclude a decrease in the activity of cement during long-term storage. Therefore, the task of finding a way to facilitate long-term storage of finely ground additives or cement becomes urgent.

One of the ways to eliminate this shortcoming in the production and use of cement can be achieved by producing a mineral mixture from the components of the cement grinding mixture. This method makes it possible

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to obtain a wide range of cements immediately before using cement in construction work at construction sites.

Thus, the purpose of this work is to study the influence of modified mineral additives obtained by modifying waste from metallurgical and processing industries on the strength properties of cements.

For the research, Portland cement clinker of Bekabadcement JSC, fractional steelmaking waste (FOSPP) with a particle size of less than 5 mm of Uzmetkombinat JSC, flotation waste from lead-zinc ore enrichment (SOF) of the Almalyk Mining and Metallurgical Combine (AMMC) and sand waste were taken as objects. kaolin enrichment (hereinafter referred to as KAOL). The chemical composition of the starting materials is given in table. 1.

Table 1. Chemical composition of starting materials

Materials	Content, mass. %							
	SiO_2 _	AI_2O_3 _	Fe_2O_3 _	CaO	MgO	SO 3	P.P.P.	S
Clinker	22.48	4.08	4.03	2.02	64.07	1.32	1.04	99.04
TOOK	50.62	11.97	10.54	5.56	2.21	3.20	13.35	97.45
FOSPP	18.60	5.22	20.10	41.58	12.55	0.15	3.05	101.25
SOF	45.75	8.72	7.11	14.59	7.10	2.98	8.83	95.08

In the first case, the modified additive is obtained by mixing FOSPP with a particle size of less than 5 mm and SOF in the following

component ratio (wt.%): FOSPP 25-67; SOF 33-75. Modification of additives was carried out by mechanical activation in a laboratory ball mill MBL-1 with a standard loading of grinding balls and ground material. The dimensions of the additive components used (FOSPP with a particle size of less than 5 mm and SOF in the form of sand of a fraction of 0-1 mm) allow them to be used directly by introducing cement clinker, gypsum and additives into the mill when grinding. In this case, mechanical activation of the additive occurs during cement grinding, which saves energy and time for obtaining a finely ground additive. A sufficiently high content of SiO2 and Fe2O3 in the waste promotes self-cleaning of the mill wall and balls and thereby is a factor in increasing the productivity of the grinding unit.

Physical and mechanical tests of cements are carried out according to GOST 310.1-76, 310.3-76, 310.4-81, and frost resistance is determined according to OzDSt 10060.1-95.

As can be seen from the test results, the optimal content of MD in cement is 15-25 wt.% (compositions 1-7), where a decrease in the grade of cement is not observed. An increase in the amount of MD by more than 25% leads to a decrease in the grade of cement (compositions 9-11). Increasing the amount of SOF to 80 wt.% in the composition of MD also leads to a decrease in the grade of cement (composition 8). The frost resistance of cements is 70-75 cycles of alternating freezing and thawing.

In the second case, modification of the additive was carried out by heat treatment of kaolin enrichment waste. TOOK is a product of heat treatment at 650-850 oC of sandy waste from the enrichment of kaolin from the Angren deposit. Sandy waste from kaolin enrichment is formed during flotation enrichment of kaolin at Angren Kaolin LLC.

The manifestation of hydraulic activity by sandy waste from kaolin enrichment during its heat treatment is due to the fact that physicochemical processes occur in the structure of kaolin enrichment waste that contribute to an increase in their hydraulic activity. Quartz compounds undergo isomorphic transformations and transform into a more active form of silica, which contribute to the active binding of CaO released during the hydration of cement minerals, and clay minerals contained in the kaolin enrichment waste also undergo structural changes, that is, dehydration of kaolinite occurs and its transition to more active form - metakaolinite.

From laboratory-ground cements of clinker, gypsum and the addition of TOOK, crushed to a specific

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surface of about 300 m2/kg, in accordance with GOST 310-81, samples are formed - prisms measuring 40x40x160 mm, which after steaming or after 28 days of hardening in water are tested for strength at compression.

Examples of introducing the TOOK additive with the highest activity and the properties of laboratory-ground cements in an MBL-1 ball mill with the TOOK additive, as well as its mixture with other most common mineral additives, are given in Table. 1.

That additive-free cement has a compressive strength after 28 days of water hardening of 42.2 MPa and corresponds to the “400” grade. When adding 5-20 wt.% TOOK, the strength characteristics do not decrease, and in some cases (examples 1, 2, 5, 7, 8, 11) increase up to 5%.

1) Results

The optimal amount of TOOC in the composition of cements is 15-20 wt.%. The strength of cements corresponds to grade “400”. Increasing the amount of additive is undesirable, since a decrease in the grade of cement is observed. TOOC can be combined with other known additives in the specified

within the composition of cements. For example, TOOC can be combined with 5-10 wt.% fuel ash or slag. When using TOOK and FOSPP together, the share of the latter is 5-20 wt.%.

Thus, the positive effect of the above modified additives on the strength properties of cements has been established. The use of FOSPP, SOF and TOOK as MD leads to energy savings for cement grinding and a reduction in the cost of cement. The proposed additive and methods for preparing cement additives open up a wide opportunity for recycling industrial waste in cement production, improves the environment in the industrial region, and also stabilizes the physical and mechanical properties of cement products.

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