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METHODS FOR OBTAINING A COMPOSITE GYPSUM BINDER BASED ON SAMARKAND AND BUKHARA STUCCO

Annotation: An analysis of the study of obtaining gypsum binders using the filler Bekabad metallurgical slag with a chemical additive is given. The possibility of controlling the physical and mechanical properties of a gypsum binder with the help of a filler and additives is shown. A comparison of the production of gypsum binder by various methods is shown, as well as the results of testing a gypsum binder based on Samarkand and Bukhara building gypsum.

Key words: slag filler, chemical additive, polycarboxylatesuperplasticizer GLENIUM 27S, metallurgical slag.

INTRODUCTION

Recently, the demand for gypsum binders has increased both in the building materials industry, especially in the production of dry mixes, and in other industries.

The task of creating gypsum binders for various purposes, modified with a rationally selected complex of local mineral fillers using highly effective chemical additives that are available and competitive in quality [10,11,12,13], is very urgent.

The purpose of this article is to study the physical and technical properties at various specific surface areas (from 90 to 500 m2 / kg) of slag and the choice of a method for producing a gypsum binder with a filler of metallurgical slag and the addition of a polycarboxylate superplasticizer. As an object of research were selected: gypsum binder of the Samarkand and Bukhara gypsum plant, mineral

filler slag of the Bekabad metallurgical plant with the addition of polycarboxylate superplasticizer GLENIUM 27S [4,2,6,18,20,21].

The studies were carried out using modern methods of physical and mechanical research, the analysis of the physical and technical properties of Bukhara and Samarkand stucco with a filler of metallurgical slag and a plasticizing additive was carried out [3, 16].

MATERIALS AND METHODS

Getting stucco is possible in various ways from raw materials of different fractional composition [1-6], while in order to achieve the required properties, the optimal mode of heat treatment must be selected. Since gypsum compositions can use stucco obtained by different methods (and, therefore, having differences in phase composition and properties), it was necessary to carry out comparative tests of the properties of the composition obtained on the basis of such binders.

To study and compare the properties of gypsum compositions based on Samarkand and Bukhara stucco, compositions were prepared, which contained 20% of the Bekabad metallurgical slag with different specific surface area (from 90 to 500 m2 / kg).

The results of the experiments are shown in tables 1 and 2.

Table 1.

Physical and technical properties of the binder obtained on the basis of the Samarkand stucco

Specific metallurgical slag surface, m2 / kg	Compositionproperties				
	Normaldensity,%	Settingtime, min.		Compressivestrength	
		Start	theend	MPa	%
-	56	6	8	6.2	10
90	55	6	8	6.1	9.6
150	56	7	9	6,1	9.6
300	56	7	9	6.4	10.6
500	57	9	14	6.8	11

Table 2.

Physical and technical properties of a binder obtained on the basis of Bukhara stucco

Specific metallurgical slag surface, m2 / kg	Compositionproperties				
	Normalden sity,%	Settingtime, min.		Compressivestrength	
		Start	theend	MPa	%
-	46	5	6	7.2	10
90	50	4	5	7.2	10
150	51	4	5	7.5	11
300	51	5	6	7.9	12
500	52	4	5	8.2	17

The analysis of the results obtained showed that the general regularities of changes in the properties of gypsum compositions, regardless of the type of binder on the basis of which they were obtained (Samarkand and Bukhara stucco), remain: with a constant amount of slag, the water demand and setting time of the binder, regardless of the specific surface area of the additive, practically do not change. In this case, with an increase in the specific surface area of the used slag, an increase in the strength of the gypsum stone is observed[22-25].

Comparative studies of the properties of binders obtained on the basis of the Samarkand and Bukhara gypsums showed the following: the water demand of the composition prepared on the gypsum of a more homogeneous phase composition is 5% lower, the setting time practically does not change, and the strength of the gypsum stone increases by 0.5 times. It should be noted that if, in order to increase the strength of gypsum stone by 11%, it is necessary to introduce slag with a specific surface area of 500 m^2 / kg in the composition of Samarkand gypsum, then when using Bukhara gypsum, it is sufficient to grind it to a specific surface area of 150 m^2 / kg. This will reduce the energy consumption for grinding the additive.

The use of a filler with a specific surface area of 300 and 500 m^2 / kg in a binder obtained according to the optimal mode increases the strength of gypsum stone by 12 and 17%, respectively. The choice of the specific surface area of the slag should be based on the required properties of the composite gypsum binder.

RESULTS AND DISCUSSION

Based on the above, the following conclusions were drawn:

- regardless of the type of binder (Samarkand or Bukhara gypsum), on the basis of which gypsum compositions modified with slag were obtained, the general regularities of changes in their properties remain: with the introduction of a filler of various specific surface areas, the water demand and setting time of the binder do not change, the strength of the gypsum stone increases with an increase specific surface area of the additive;

- gypsum compositions made on a binder of a more homogeneous phase composition have a lower water demand (there is a decrease in the normal density by 5% compared to the binder on the Samarkand gypsum) and, as a result of hardening, form a more durable gypsum stone (strength increases by 0.5 times);

- the use in the composition of the gypsum binder, obtained according to the optimal mode, slag with a specific surface area of 150, 300 and 500 m^2 / kg increases the strength of the gypsum stone by 11, 12 and 17%, respectively, while to achieve the effect of increasing the strength, it is sufficient to grind the additive to the specific surface of 150 m^2 / kg (when using Samarkand stucco) not less than 500 m^2 / kg), which will reduce energy consumption for grinding the filler.

One of the factors affecting the physical and technical properties of gypsum binders is the method of its production. The choice of the method of introducing slag into plaster of paris (Bukhara). Three methods of obtaining gypsum compositions were considered, depending on the preparation of the mineral additive:

The first method involves heat treatment of gypsum stone to hemihydrate, grinding it to medium fineness and further mixing with pre-ground to zero residue on a sieve No. 008 metallurgical slag (20%) and GLENIUM 27S (1%) (Fig. 1).

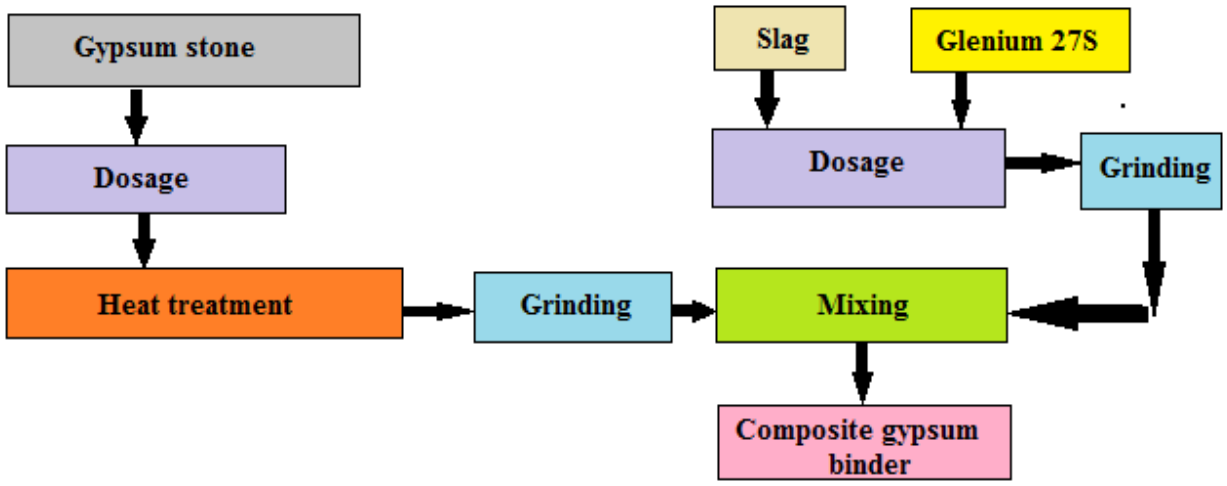

Fig. 1. Obtaining a composite gypsum binder according to the first method

The second method involves heat treatment of the raw mixture consisting of gypsum stone and slag (20%) and GLENIUM 27S (1%), previously ground together to zero residue on a sieve No. 008, followed by grinding the heat treatment products to medium fineness (Fig. 2)

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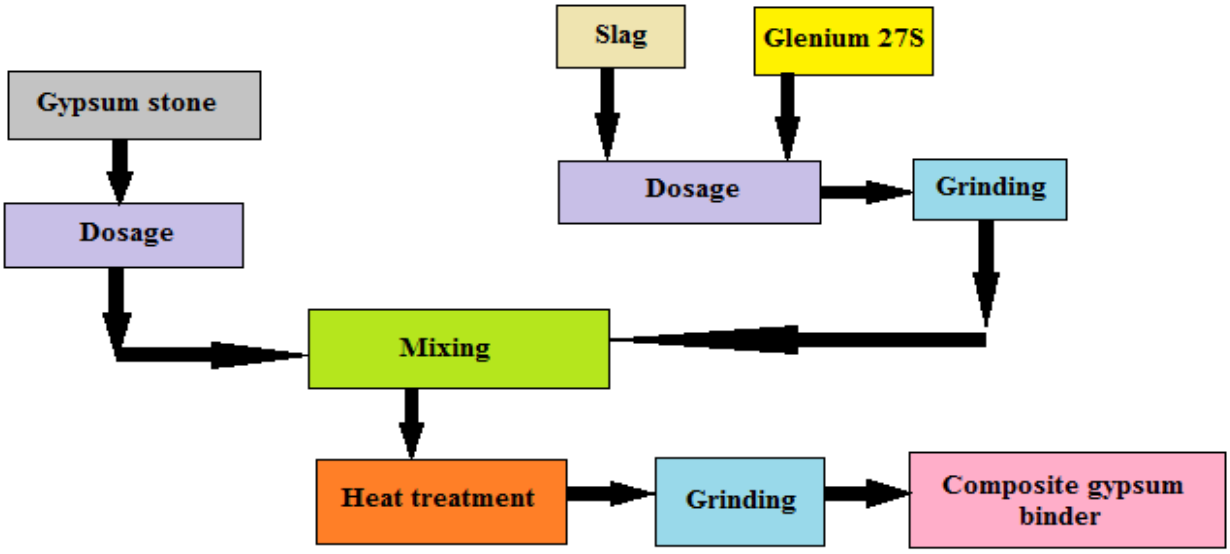

Fig. 2. Obtaining a composite gypsum binder according to the second method

The third method involves heat treatment of the raw mixture consisting of gypsum stone, slag (20%), superplasticizer GLENIUM 27S (1%), followed by grinding the heat treatment products to medium fineness (Fig. 3).

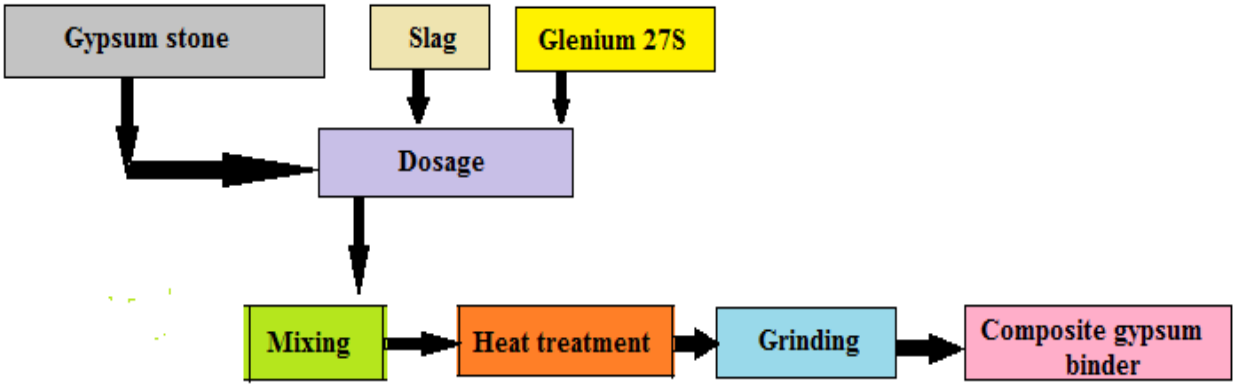

Fig. 3. Obtaining a composite gypsum binder according to the third method

The binder composition obtained by the second method was taken as a control one.

The results of determining the physical and technical properties of the composition depending on the method of combining GLENIUM 27S, metallurgical slag and gypsum stone are shown in (Table 3).

Table 3.

Influence of the method of introduction of the superplasticizer GLENIUM 27S on the physical and technical properties of binder and gypsum stone based on it

No. way	Properties of a composite gypsum binder				
	Normal density,%	Timing setting, min.		Tensile strength with compression (at the age of 28 days),%	Density,%
		Start	End		
Control.	47	10	12	13.0	10
1	40	4	6	13.8	10.6
2	40	4	6	14.5	12
3	40	4	6	13.4	10.3

The analysis of the properties of the obtained compositions showed that regardless of the method of introducing the GLENIUM 27S superplasticizer into the composition, the water demand of the binder decreases by 7%, the setting time is accelerated from 10 and 12 minutes (the control binder composition) at the beginning and end, respectively, to 4 and 6 minutes.

Any of the considered methods of using the GLENIUM 27S superplasticizer and slag additives can improve the strength and density of gypsum stone, therefore

the choice of the most acceptable should be based on the required properties and the availability of equipment.

An increase in the strength of gypsum stone by 13.8% and density by 10.6% is facilitated by the first method, which involves the separate production of the components of the mixture (stucco and modifier from metallurgical slag and GLENIUM 27S) and their subsequent mixing.

From the point of view of increasing the strength of the gypsum stone, the best performance is achieved with the second method. At the same time, the strength and density of the gypsum stone increase by 14.5 and 12%, respectively, and the components of the binder undergo both thermal and additional mechanical activation.

The third method, which excludes the operations of preliminary grinding of the slag and the GLENIUM 27S superplasticizer, is the simplest and most economical in terms of technology and equipment. The strength and density of the gypsum stone based on the gypsum composition obtained by the third method increase by 13.4 and 10.3%, respectively.

CONCLUSIONS

Based on the above, the following conclusions were drawn:

- introduction of GLENIUM 27S superplasticizer together with metallurgical slag into the raw mixture before heat treatment allows to reduce the water demand of the binder, but accelerates the setting time; at the same time, the change in these indicators of properties does not depend on the method of introduction of the superplasticizer GLENIUM 27S;

- each of the considered schemes makes it possible to improve the physical and technical properties of gypsum stone based on the composition, therefore, the choice of the most acceptable of them should be based on the required property indicators and the availability of equipment;

- it has been shown that when using Bukhara stucco, the first method can be used, which assumes the separate production of components (stucco, modifier from slag and superplasticizer GLENIUM 27S), while the strength and density of the

gypsum stone increase in comparison with the control composition by 13.8 and 10.6%, respectively;

- it was found that the strength and density of a gypsum stone based on a binder obtained by the second method increases by 14.5 and 12%, respectively, compared with the control value;

- it is shown that the simplest from the point of view of the production technology is the third method, which makes it possible to exclude the operations of preliminary grinding of the components; the strength and density of the gypsum stone based on the composite gypsum binder obtained by the third method increases by 13.4 and 10.3%, respectively.

The established patterns of changes in the properties of binders depending on the method of their production, including the order of introduction of the mineral additive and superplasticizer, served as the basis for the development of a technological scheme for the production of a composite gypsum binder.

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