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Compositions for Interior Walls of Buildings on the Basis of Local Materials

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Abstract

The data on the effect of roasting of diatomite on the properties of lime: diatomite compositions. The questions of the distribution of adsorption centers on the surface of diatomite

Keywords: diatomite, burning, lime-diatomite compounds, adsorption sites, strength

Introduction

It is known that containing silica active mineral additives in a finely divided state in the presence of moisture can react with calcium hydroxide. Activity of the additives consisting mainly from amorphous silica, considerably grows with increase of a subtlety of a grinding and depends on the size of initial particles amorphous silica

Activity diatomite increases after calcination at a temperature 600-800^{0}C.

Calcination increases the chemical activity of the surface by increasing the number of active centers [1, 2]. Many processes occur on the active centers.

Therefore, the active sites of the surface of the fillers will influence in condition their reactivity and the effect on the interactions in the system "binder-filler." The nature of the material surface energy heterogeneity determines its chemical properties.

Results of researches

In the present study investigated the acid-base properties of diatomite. In developing the finishing mixtures as a filler used diatomite Akhmatova field Penza

region. To study the active sites of the surface of diatomite used indicator method. Investigations were carried out in range the Brønsted centers(pKa of from 0 to 7) and (pKa of from 7 to 13) and range Lewis centers (pKa> 13).
On Fig 1 curve distributions of the centers of adsorption to surfaces diatomite in a natural condition and diatomite, are submitted to thermal processing at temperature t=700^{0}C, constructed in coordinates:
qpKa=F (pKa),
where qpKa – the contents of the active centers, equivalent to quantity of the adsorbed indicator of certain acid force - pKa.

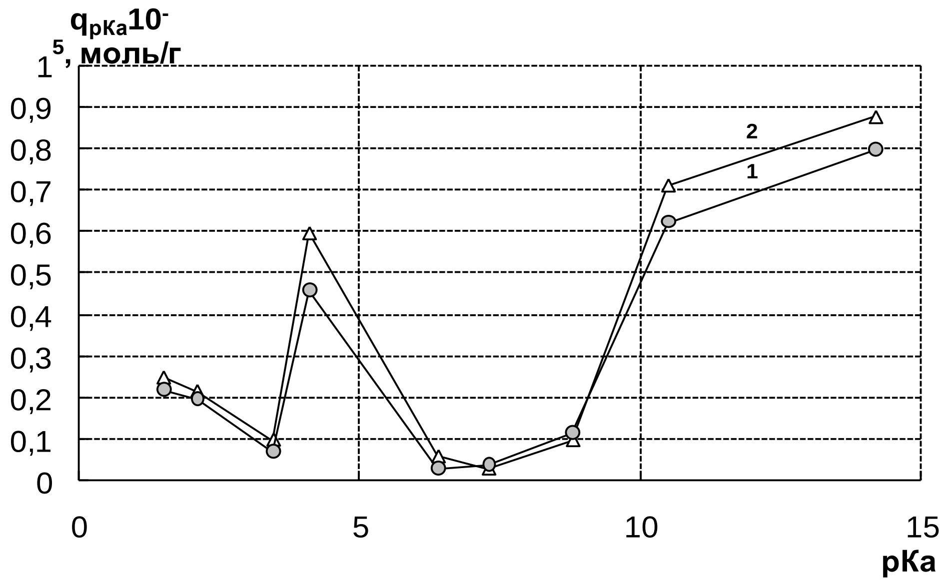

Fig. 1. Distribution of acid-base centers on the surface of the filler dry mix 1 - unbaked diatomaceous earth; 2 - diatomite, heat treated at t = 700^{0}C.

Research results show a significant difference in the activity of the surface of the unburned and burned diatomite, and is not only the number of adsorption centers of different types, and the total content of the adsorption centers. The impact of the temperature factor has led to a change in the energy state of the material surface, manifested in changing the distribution of adsorption centers. Comparing the distribution of adsorption sites on the surface of the materials having substantially the same chemical, mineralogical composition and particle size distribution indicates that the number of Bronsted acid sites on the surface of the thermally treated diatomite exceeds the number of the same sites on the surface of the unburned diatomite. Thus, the number of active centers with a pKa of from 0 to 7 on the surface was calcined diatomite $1{,}215 \cdot 10^{-5}$ mol / g, while on the surface of the unburned diatomite - $0{,}975 \cdot 10^{-5}$ mol / g. In the basic Bronsted centers (pKa of from 7 to 13) there was a slight reduction in the number of active sites on the surface of the thermally treated diatomite.

Change of activity diatomite after his roasting promotes increase in durability of lime-diatomite composites. Definition of strength at compression carried out on dynamometer ДОСМ-3-1. Table 1 shows experimental data of the compressive strength specimens of dimensions 3x3x3 cm in 28 days based on diatomite, calcined at different temperatures.

The analysis of the given tab. 1 testifies, that heat treatment diatomite at low temperatures (200^{0}C and 300^{0}C) does not render essential influence on values of durability at compression. The increase in temperature of roasting up to 700^{0}C results in increase durability at compression up to R=4,38 MPa. However the greatest effect is reached at heating diatomite at temperature t=900^{0}C. Value of strength at compression has made R=5,1 MPa. At temperature of roasting

Table

Durability at compression of a composition in dependence from temperature of heat treatment diatomite

Processing temperature, ^{0}C	The compressive strength at age 28 days, MPa
20	0,9
200	0,94
300	0,98
700	4,38
900	5,1

Note. The ratio of lime: diatomite = 1:3

700^{0}C and 900^{0}C diatomite gets brightly orange shade that allows to diversify color scale of a finishing layer without introduction of pigments. However, from the viewpoint of energy more firing filler treatment at t = 700^{0}C.

Experimental data of strength have been received at compression of lime-diatomite structures at a various parity of components of a dry mix and at the presence of additives.

Analysis of the experimental data showed that the samples with a high content of diatomite have greater compressive strength. Thus, the compressive strength of the samples with the ratio of lime: diatomite 1: 1 was 0.44 MPa; a ratio of 1: 2 - 0.6 MPa, while lime-diatomite ratio of 1: 3 - 0.9 MPa.

Found that an increase fineness of the filler dry mixture leads to an increase in the strength characteristics of lime-diatomite compositions. The compressive strength of the samples containing diatomaceous coarser (0,63- 0,31 fraction) was 0.68 MPa, and the application of diatomite fraction 0,3-0,14 - 0.9 MPa.

The experimental data showed that the lime-diatomite compositions had a low strength. In this connection, in order to improve the strength characteristics and reduce shrinkage strain in the mixture injected additive aluminum sulfate $Al_2 (SO_4)_3$.

It was found that with increasing additive content of aluminum sulfate increases compressive strength. Thus, the compressive strength when the content was $Al_2 (SO_4)_3$ in an amount of 2% by weight of the dry components - 1.1 MPa in amounts of 5% - 1.9 MPa, at 10% - 2.1 MPa. It is necessary to note, that the increase in percentage of sulfate of aluminium about 2 % up to 5 % has raised durability at compression of finishing structure in 2,2 times. The further increase in quantity of the additive of sulfate of aluminium $Al_2 (SO_4)_3$ in a mix up to 10 % has led to insignificant increase of durability at compression (in 1,1 times in comparison with lime-diatomite structure with contents $Al_2 (SO_4)_3$ in quantity of 5 %). Therefore the optimal is introduction in a compounding of a mix of the additive of sulfate of aluminium in quantity of 5 % from weight of dry components.

In addition for an estimation of structurization lime-diatomite composites it was investigated kinetics of free lime CaO. Storage of the samples occurred in the conditions that impede access and the flow of CO_2.

Analysis of experimental data suggests that over time, a decreased amount of free lime. The age of 3 days the amount of free lime CaO in the composition 1:3 (lime: diatomite) is 0,137g / ml and 28 days - 0,068g / ml. Introduction of an additive increases the amount is chemically bound lime. The content of free lime in the age of 28 days was 0.063 g / ml.

The lowest content of free lime to the 28th day of hardening is observed in compositions with calcined diatomite (0.056 g/ml) The obtained results are consistent with the kinetics of curing. The data show that the curing process can be described as an S-shaped curve indicating the existence on the early stages of formation of neoplasms having a coagulation structure. The growth of the crystal structure was observed after 14 days of hardening. The presence of additives of $Al_2 (SO_4)_3$ increased the strength development of lime-diatomitote compositions. The curing speed was between 7-14 days 0.01 MPa/day, while the control composition - 0.003 MPa / day.

Conclusions

Generalization of results of experimental researches has allowed to establish an optimum parity of components, and as to define concentration of additives. The composition is optimal at the component ratio of lime: diatomite = 1: 3 with the addition of aluminum sulfate in quantity of 5 % from weight of dry components

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