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Influence of the Mode of Synthesis of the Filler on Structure and Properties of Limy Dry Construction Mixes

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Abstract

In the article results of researches of influence of the synthesized fillers based on the calcium silicates on properties of coverings based on the limy dry construction mixes are presented. High hydraulic activity of the synthesized fillers is established. Decrease of amount of free lime in limy samples with additive of synthesizable hydrosilicates, increase of durability are revealed.

Keywords: filler, calcium silicates, dry construction mixes, diatomite

1 Introduction

Increase of operational properties of building materials including coverings based on dry construction mixes (DCM) can be provided by introduction in their compounding of nanodispersible additives capable to regulate structurization of material [1,2,3,4].

The earlier conducted researches showed the effectiveness of application in limy composites of additives based on the calcium hydrosilicates (HSC) received by synthesis from a liquid silica glass in the presence of an additive-precipitant ($CaCl_2$) with the subsequent drying of precipitation and its crushing [5, 6].

2 Experimental study

By the X-ray phase analysis method it is established that degree of a crystallization of the synthesized hydrosilicates is low, calcium hydrosilicates of various basicity are formed. Considering that the low-basicity calcium hydrosilicates possess higher durability, throughout further researches at synthesis of filler the materials containing amorphous silicon dioxide, in particular, Inzensky diatomite with a specific surface area Ssp = 17112 cm^2/g and average particle size equal 1,3 μm are used follow-up.

In the work the following mode of synthesis was applied. Diatomite was added to 15% solution of $CaCl_2$, after hashing sodium liquid glass with a density of 1,279 g/cm3 and the module M=2,8 was entered. The received mix was hashed and filtered. The precipitate was dried at a temperature 100° C to the constant weight. At synthesis of a filler a ratio liquid:solid phase varied in ratios: 1) L:S=1:15; 2) L:S=1:7,5; 3) L:S=1:3,75; 4) L:S=1:3. After drying synthesizable filler was crushed to a specific surface area of =18000 cm^2/g with the average particle size equal 1,5 μm.

The scanning raster electronic microscope of Shanning Electron Microscope JSM – 6390 LV was applied to studying of structure of a synthesizable filler. Shooting was carried out in the mode of a low vacuum with a pressure P = 50 Pa.

3 Results and discussion

At an assessment of structure of a synthesizable filler it is established that the structure of diatomite is characterized by the microcracks testifying about its colloid nature (figure 1). The structure of the filler synthesized without diatomite is presented by formations of a different shapes lamellar and needle, corresponding to calcium hydrosilicates (figure 2). At studying of structure of the filler synthesized in the presence of diatomite it is established that diatomite is a substrate on which calcium hydrosilicates are formed (figure 3).

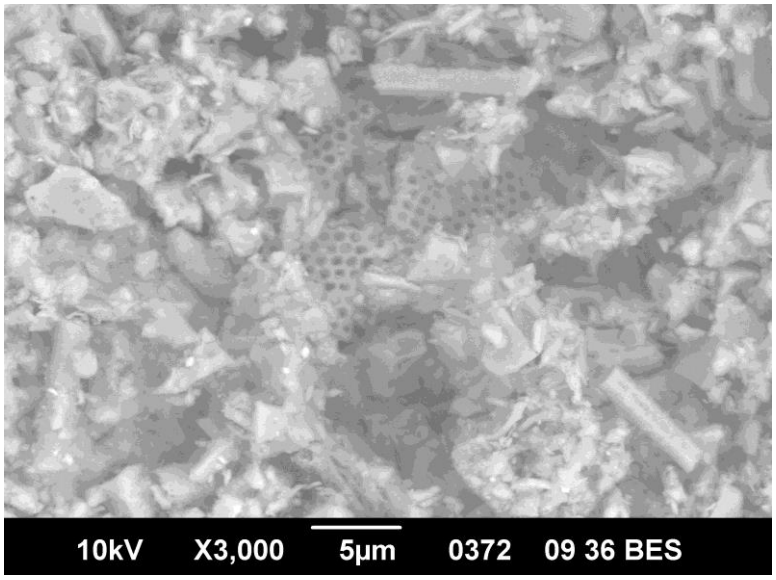

Figure 1: The image of diatomite structure × 3000

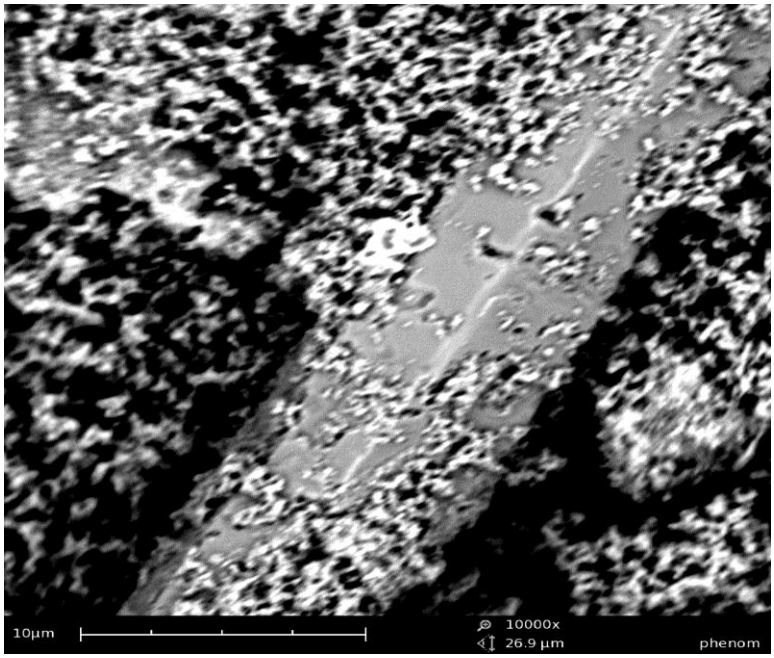

Figure 2: The image of structure of the synthesized filler based on calcium hydrosilicates × 2500

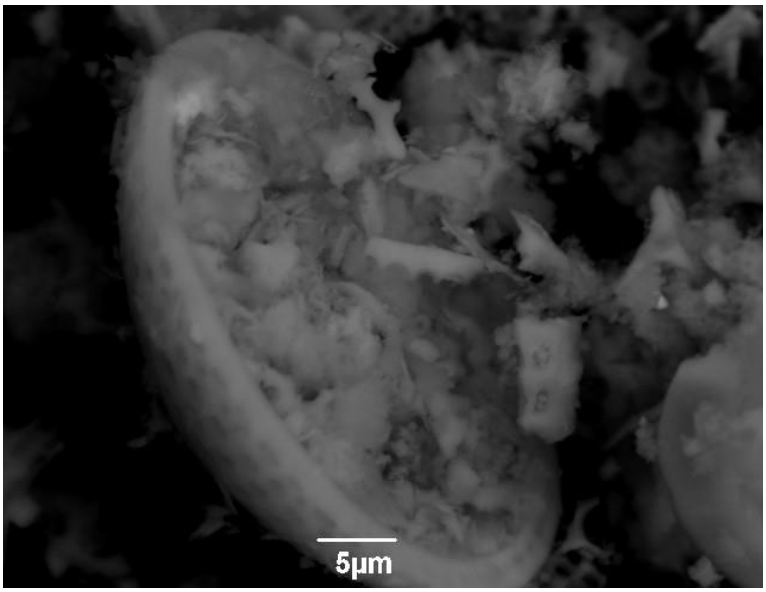

Figure 3: The image of structure of the filler synthesized in the presence of diatomite ×3000

The filler synthesized in the presence of diatomite possesses high hydraulic activity, a component more 400mg/g [7] (table 1).

Table 1: Filler active depending on the synthesis conditions

Synthesis mode	Solubility, %	Activity mg/g
Additive without diatomite	68,2	370
(Ж:Т)=1:15	73,2	>400
(Ж:Т)=1:3	79,5	>400
Diatomite	68	370

Effectiveness of the synthesized additive was estimated on the example of limy compositions. Mixes with the water-limy ratio W/L=1/1were prepared. As the binder powdered lime was applied. Lime activity made 86%. The filler amount changed from 10 to 30%. Samples hardened in air-dried conditions.

It is established that at increase of amount of diatomite in a compounding of the synthesized additive the increase of compressive strength of limy composite is observed. The compressive strength of samples at the age of 7 days of hardening in air-dried conditions at a temperature 18-20°C makes Rc = 0,925 MPa (control composition). Limy samples based on the compositions containing the synthesized calcium hydrosilicates in amount of 30% (synthesis without diatomite), have the compressive strength equal to Rc = 2,575 MPa, and samples based on the compositions with the filler synthesized in the presence of diatomite at a ratio L: S=1:3 - Rc=3,3 MPa.

Decrease of the amount of free lime in limy samples with an additive of synthesizable hydrosilicates is noted. It is established that amount of free lime in limy composites hardening in air-dried conditions makes 44,6% (control composition), and in limy samples based on the compositions containing the synthesized calcium hydrosilicates in number of 30% (synthesis without diatomite)-29,8%, and in samples based on the compositions with the filler synthesized in the presence of diatomite at a ratio L:S=1:3 - 23,4%.

4 Conclusion

Thus, the offered mode of synthesis of a filler in the presence of the materials containing amorphous silicon dioxide allows to receive the additives based on calcium hydrosilicates possessing larger effectiveness of interaction with a lime that allows to increase operational properties of limy composites.

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