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THE RHEOLOGICAL PROPERTIES OF THE FINISHING LIME COMPOSITION WITH ADDITIVE BASED ON SYNTHETIC ALUMINOSILICATES

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ABSTRACT

The information about the patterns of structure formation of lime compositions with the additive based on synthetic aluminosilicate . It is shown that the introduction of additives based on synthetic aluminosilicate helps to speed dial plastic strength.

Keywords: dry building mixes, additive based on synthetic aluminosilicate, plastic strength.

1. INTRODUCTION

For restoration of facades of historical buildings are widely used lime compounds [1]. However, the low operational resistances lime coatings leads to an increase overhaul costs. In [2, 3, 4, 5] proposes to improve the durability of lime coatings the introduction of synthetic additive (calcium silicate, aluminosilicate, organo-mineral)

In the course of further research we have established the possibility of regulation of structure and properties of lime compositions introduction of additives based on synthetic aluminosilicate [6].

2. MATERIALS AND RESEARCH METHODS

Used hydrated lime 2 grade with an activity of 86%, specific surface S_{sp} = 11800 cm^2/g.

The synthesis of aluminosilicate is their precipitation from solution of aluminum sulfate $Al_2(SO_4)_3$, with the addition of sodium silicate followed by washing the precipitate with water. When designing synthesis technology additives investigated the effect of sodium silicate modulus, the pH of the solution of aluminum sulfate $Al_2(SO_4)_3$, the amount of sodium silicate, the pH of the filtrate.

It found, that at pH >5 solution aluminum sulfate Al_2 $(SO_4)_3$ precipitate is no formed. At pH = 1.5 and the application of liquid glass with module M = 2.69 output of the finished product is 81.66%, and in the application of liquid glass with module M = 2.88 - 90.05%.

In assessing chemical composition of additive found silica oxides, constituting 56.21% (Table-1)

Analysis of the size distribution Particle, made using Fritsch Sizer Analysette 22 laser automatic diffractometer show that less than 0.01% are particle of size 0,010-0,500 micron, content of particle size 100,000-200,000 microns is 0.44%.

Table-1. The chemical composition of the synthetic aluminosilicate.

Name oxide	Content, [%]	Name member	Content, [%]
SiO_2	56,21	Si	26,28
Al_2O_3	7,58	Al	14,17
SO_3	16,79	Sx	6,72
Na_2O	19,1	Na	4,01
CaO	0,0938	Ca	0,0671

Less than 5% are particles with a diameter 3.226 micron, less than 15% - a particle diameter of 6.985 microns. The value of the specific surface area is S_{sp} = 4950.44 cm^2/cm^3 (Table-2).

Table-2. Size distribution of the additive.

Fraction mkm	Content, [%]
0,01–0,5	0,01
0,5–2,0	1,81
2,0–3,0	2,55
3,0–4,0	2,8
4,0–5,0	2,73
5,0–10,0	12,61
10,0–20,0	16,61
20,0–45,0	27,2
45,0–80,0	29,14
80,0–100,0	4,09
100,0–200,0	0,44

Plastic strength or yield stress of the mixture was determined by plastometer KP-3. Plastic strength determined by the formula:

$$\eta = \tau = \tau_o = k\frac{P}{h^2}, \quad (1)$$

where
η - plastic strength;
τ - shear stress;
τ_o - yield stress;

k - coefficient, depending on the value of the vertex angle of the cone; for the metal cone with an apex angle of 30º - k = 1,116;

P - the weight of the movable part of the device (load);

h - depth of immersion of the cone in the mortar mixture.

3. THE RESULTS OF STUDIES

Figure-1 shows the values of strength plastic lime paste with the addition of synthetic aluminosilicate. For comparison used additive metakaolinite and kaolinite. The paper used the lime with an activity of 84.4%. Ratio water: lime W / L = 1.0

Analysis of the data, shown in Figure-1, shows, that the addition of synthetic aluminosilicate accelerates the process of structure formation of lime systems. Thus, plastic strength (control composition) after 10 hours of mixing τ = 0.0022 MPa. At introduction additive based on synthetic aluminosilicate in an amount of 10% by weight of the lime plastic strength after 1 hours of mixing was τ = 0,038 MPa at pH = 5 the filtrate (Figure-1, curve 2). Washing of the precipitate in the synthesis process to pH = 9 reduces the activity of synthetic additives. Growth of plastic strength is observed after 5 hours of mixing (Figure-1, curve 1).

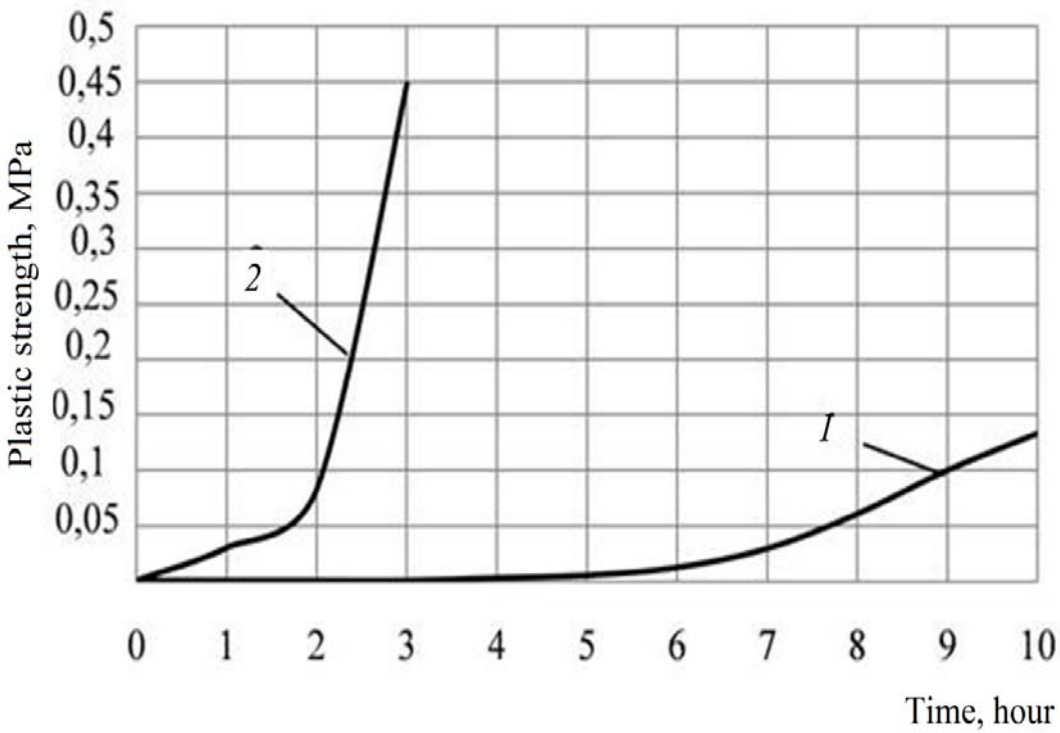

Figure-1. Change lime plastic strength at introduction additives based on synthetic aluminosilicate:
1- content of additives of 10% by mass lime (additive synthesized from solution $Al_2(SO_4)_3$ with pH = 3, and washed until the filtrate pH = 9);
2- additive content of 10% by mass lime (additive synthesized from solution $Al_2(SO_4)_3$ with pH = 1.5 and washed until the filtrate pH = 5)

Washing of the precipitate in the synthesis process to pH = 9 reduces the activity of synthetic additives. Growth plastic strength is observed after 5 hours of mixing (Figure-1, curve 1).

Additives' roasting at 500 °C enhances its activity. It accelerates of lime paste structuring (Figure-2, curve 3). When the content of additives in an amount of 1-3% by weight of lime, strength plastic after 2 hours of mixing is τ = 0,012 -0, 63 MPa (Figure-2, curves 4 and 5).

Increasing the content of additives based on roasted synthetic aluminosilicate to 10% results to greater speed formation structures. Plastic strength after 2 hours is τ = 0,08MPa (Figure-2, curve 6). Additive of metakaolinite at content 1-3% by weight of lime does not cause an early structuring (Figure-2, curves 1, 2).

When administered additive of kaolinite in an amount 1-3% by weight of lime acceleration formation is observed only after 15 hours of mixing (Figure-3, curves 2 and 3). At the age of 20 hours at content of additives kaolinite 1-3% the plastic strength is τ = 0,005-0,008 MPa. Increasing the content of additives kaolinite to 10% causes

increase of plastic strength and after 5 hours of mixing is τ=0.045 MPa (Figure-3, curve 3).

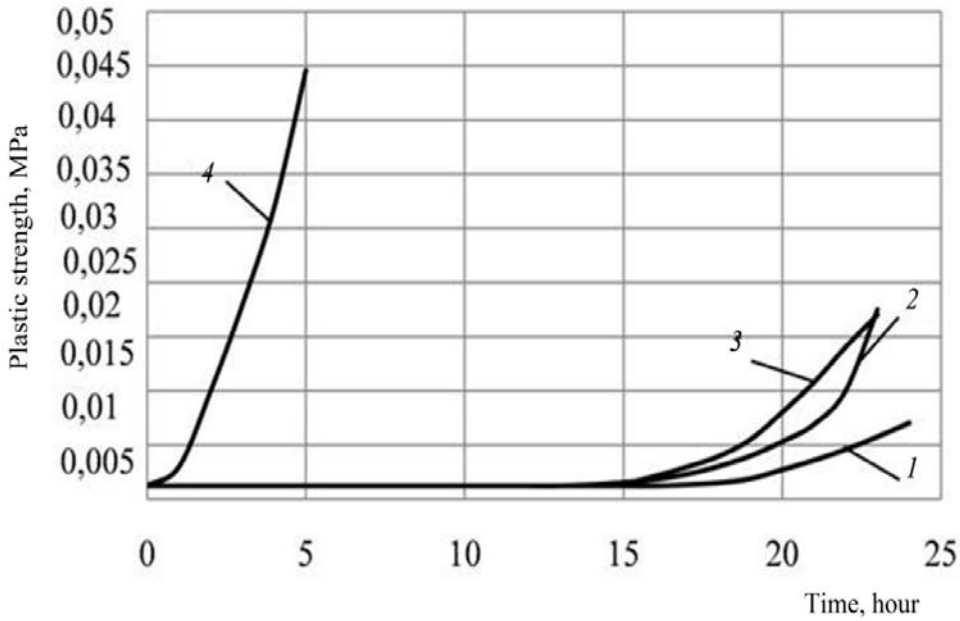

Figure-2. Changing the plastic strength at introduction additives metakaolinite (curves 1, 2, 3) and additives based on synthetic aluminosilicate (curves 4, 5, 6) in an amount by weight of lime:
1, 2, 3 - the contents of metakaolinite respectively 1, 3, 10%;
4, 5, 6 - the content of the additive based on synthetic aluminosilicate respectively 1, 3, 10% (additive synthesized from solution $Al_2(SO_4)_3$ with pH=1.5, washed until the filtrate pH = 5, and roasting at 500° C)

When administered additive of kaolinite in an amount 1-3% by weight of lime acceleration formation is observed only after 15 hours of mixing (Figure-3, curves 2 and 3). At the age of 20 hours at content of additives kaolinite 1-3% the plastic strength is τ = 0,005-0,008 MPa. Increasing the content of additives kaolinite to 10% causes increase of plastic strength and after 5 hours of mixing is τ=0.045 MPa (Figure-3, curve 3).

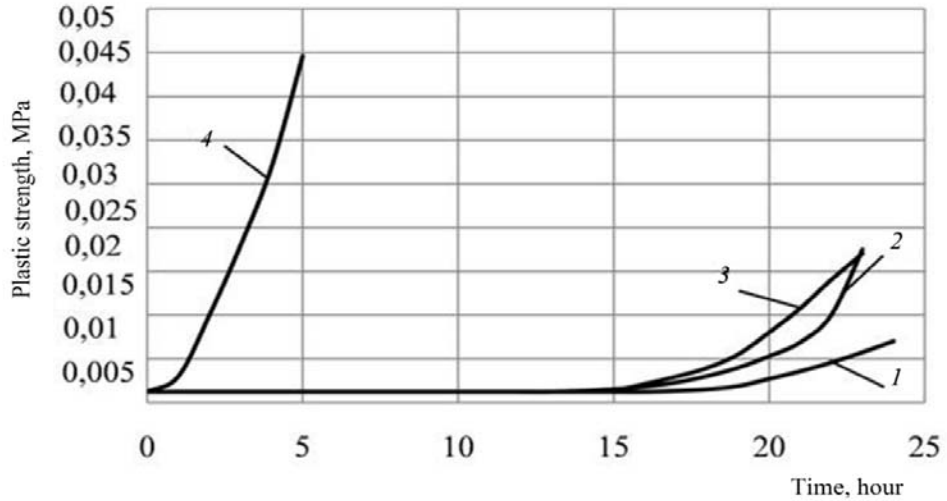

Figure-3. Change the strength of the plastic lime paste when introduced additives kaolinite:
1- control composition (without additives); 2- additive content 1%; 3- additive content 3%; 4- additive content 10% by weight lime

4. CONCLUSIONS

Thus, it was found, that a limy binder with additive based on synthetic aluminosilicate is characterized by a faster curing in comparison with pure lime binder. Limy binder with additive based on synthetic aluminosilicate are proposed use in the manufacture of dry building mixes intended for the restoration of buildings of historic buildings, as well as furnish the newly constructed facilities.

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