IMPACT: International Journal of Research in Engineering & Technology (IMPACT: IJRET)
ISSN(E): 2321-8843; ISSN(P): 2347-4599
Vol. 2, Issue 4, Apr 2014, 25-30

IMPROVING THE QUALITY OF LIME COMPOSITES

LOGANINA V. I, MAKAROVA L. V, TARASOV R. V & SERGEEVA K. A

Penza, "Penza State University of Architecture and Construction", Russia

ABSTRACT

One of the perspective directions is using the mineral fillers based on calcium silicates in a compounding of dry construction mixes. Regularities of activity change of filler interaction with lime depending on conditions of it's receiving are revealed. It is established, that using the mineral fillers in a compounding of dry construction mixes, leads to increase the functional properties of received coverings.

KEYWORDS: Dry Construction Mixtures, Resistance, Filler, Calcium Hydrosilicates

INTRODUCTION

Nowadays the improvement quality of construction materials, including DCM, from positions of providing high operational rates is a huge problem. According to prospects of the Russian market development in the construction sphere by the most significant criterion in a segment of protective and decorative coverings is the increase of durability.

The lime dry construction mixes (DCM) are often used in practice of finishing works, providing an optimum microclimate of buildings and constructions due to the high vapor permeability of coverings. At the same time these coatings have insufficient water resistance and strength that inhibits their widespread using in exterior decoration. The solution of these problems will promote to increase the durability of coverings based on limy DCM.

MAIN CONTENT

Increase the durability of coverings based on lime can be provided to DCM by introduction the components, capable to regulate pattern formation material in their compounding. One of perspective solutions of this task is using as a part of lime DCM the mineral fillers based on calcium (HSC) hydrosilicates.

In the production of the filler the following factors were taken into account: the density of liquid glass, the amount of non-solvent additive, the concentration of its solution, the mode of drying the sludge, and its storage time. It was revealed that the optimum density of sodium silicate component is = 1130-1663 kg/m^3. The amount of additive $CaCl_2$ is calculated from the stoichiometric ratio; $CaCl_2$ was administered in the form of 7.5% and 15% solution [1, 2].

It was found that the output of the filler synthesized from liquid glass in the presence of a 15% solution of $CaCl_2$ in an amount of 30 and 50% of liquid glass weight was 85%, and of the filler synthesized in the presence of 7.5% solution of $CaCl_2$ in an amount of 30% and 50% of liquid glass was 100%. After drying at 105°C the true density of the filler was 2200 kg/m^3, and the bulk density - 448 kg/m^3.

The results obtained by using an automatic laser diffractometer Fritsch Particle Sizer Analysette 22 indicate that the content of 0.05-10 micron-size particles is 18.35-24%, depending on the mode of synthesis.

The study of the qualitative composition of the newly synthesized filler with XRD, IR and electron microscopy revealed that the degree of crystallization of the samples is low [3, 4].

There formed calcium hydrosilicates of various basicity. The X-ray diffraction pattern (Figure 1) of the filler samples shows diffraction lines (E) of calcium hydrosilicates CSH (I) and CSH (II): 10.13, 4.765, 3.582, 3.145, 2.875, 2.82, 2.719, 2.466, 2.283, 2.22, 2.062, 2.013, 1.823, 1.701, 1.629, 1.603, 1.41; calcite: 3.039, 1.921, 1.877, 1.66, 1.297, 1.262; and gidrogalites: 3.858, 3.26, 1.995.

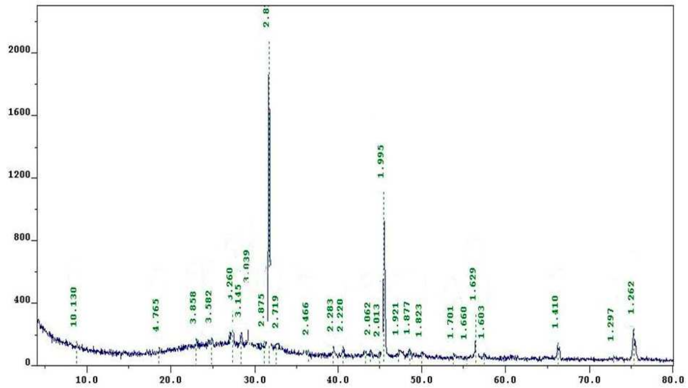

Figure 1: XRD Patterns of the Filler

The analysis of the images obtained with the electronic microscope scanner Phenom TM G2 pro (Figure 1) shows that the filler structure has the form of plate- and needle-like formations characteristic of hydrosilicate calcium.

The conducted researches show that the filler based on HSC possesses hydraulic activity. The activity of a filler defined according to a technique [5], makes 195-250 mg/g (table 1).

Table 1: Activity of the Synthesized Filler Based on HSC

Conditions of Synthesis Filler	Active Filler Mg/G
The filler synthesized from liquid sodium glass in the presence of an additive precipitator of $CaCl_2$ in number of 30% of mass of liquid glass ρ = 1335 kg/m^3, M=2,9	259
The filler synthesized from liquid sodium glass in the presence of an additive precipitator of $CaCl_2$ in number of 30% of mass of liquid glass ρ = 1135 kg/m^3, M=2,9	205
The filler synthesized from liquid sodium glass in the presence of an additive precipitator of $CaCl_2$ in number of 50% of mass of liquid glass ρ = 1335 kg/m^3, M=2,9	223
The filler synthesized from liquid sodium glass in the presence of an additive precipitator of $CaCl_2$ in number of 50% of mass of liquid glass ρ = 1135 kg/m^3, M=2,9	195
The filler synthesized from liquid sodium glass in the presence of an additive precipitator of $CaCl_2$ in number of 30% of mass of liquid glass ρ = 1663 kg/m^3, M=1,53	167
The filler synthesized from liquid sodium glass in the presence of an additive precipitator of $CaCl_2$ in number of 50% of mass of liquid glass ρ = 1663 kg/m^3, M=1,53	250

As it was noted earlier, the main indicator of quality of finishing coverings along with durability at compression at the age of 28 days is water resistance.

In the study of water resistance the specimens were prepared on the basis of structure with application of quartz sand as which applied sursky quartz sand of fractions 0,63-0,315 mm and 0,315-0,14 mm in the ratio 80:20. Density of the sand was =1527 kg/m3. As the knitting were applied hydrated lime of 2nd grade with an activity of 84%.

Additive HSC was 30% by weight of lime. For increase of plasticizing properties of solution into a compounding entered additives Kratasol PFM and C-3.

It is revealed that the mortar of samples prepared on lime knitting, filled HSC, are characterized by the increased water resistance (table 2).

Thus, the ratio of control samples is softening Krazm = 0.42, in the samples based on filled HSC knitting – 0,54. Samples with Kratasol's additive of PFM (K_{size}=0,57) and S-3 (K_{size}=0,63) have higher value of the ratio of control a softening that, apparently, is explained by existence as a part of Kratasol's additive of PFM of a hydrophobic component, and also creation of more dense structure owing to reduction of an amount of water of the mixing water.

Table 2: Properties of Limy Solutions

Structure	The Water Knitting the Relation W/K	Durability at Compression at 28 Days, MPa	Water Resistance (Softening Coefficient K_{size})
Lime:sand=1:4	1,76	0,9	0,42
Lime: HSC:sand =1: 0,3:4	1,76	1,45	0,54
Lime: HSC:sand=1: 0,3:4, plasticizer C-3	0,94	2,28	0,63
Lime: HSC:sand=1: 0,3:4, plasticizer Kratasol PFM	1,10	2,16	0,57

The additive Pulver DM 1142P was added into a compounding in number of 1% from the weight of solids for increase of cohesive and adhesive durability of coverings based on DCM.

It is established that lime structures form coverings are characterized by high porosity and a significant amount of open pores. Introduction in a compounding an additive of HSC leads to porosity reduction. Thus, the porosity of a sample based on the control structure makes P=37, 5 %, and with HSC additive – 31,6%. The introduction in structure an additive of C-3, as well as Pulver DM 1142P considering water-reducing effect can reduce the porosity to 24, 8-25, 2%. The numerical values of coefficient of water absorption, components for structures with additives Kratasol PFM and C-3 + Pulver DM 1142P respectively 0, 49 and 0, 39 kg/(sq.m · h0,5), testify that coverings according to DIN 52617 are water-repellent, hydrophobic (less than 0,5 kg/(sq.m · $h^{0,5}$) (table 3).

To improve the strength values of coating based on the DCM, redispersion powders were administered in the formula, Pulver DM 1142P and Neolith 7200, at 1% and 0.8% respectively of the weight of solids. It was found that the joint introduction of the redispersible powders, plasticizing additives, and the filler based on the CHS into the DCM formula results in an increase in compressive strength and adhesion, 4.12 MPa and 0.91 MPa respectively. The coatings based on these compositions are characterized by increased water resistance. The softening coefficient is 0.74.

To evaluate the operational stability of coatings based on lime DCM, some tests were conducted by alternating freezing and thawing of the finishing layer deposited on the cement-sand base. An assessment of the appearance of the coating was carried out in accordance with GOST 6992-68 "Paint coatings. The method of determining the stability of coating in atmospheric conditions". As a "failure" was considered a condition of the coating, estimated as III.4 points.

It was found that the painted samples withstood 50 cycles of tests, with the condition of the coating after 50 cycles of testing evaluated as V.5 points. Such condition is characterized by the loss of gloss up to 5%, a surface mesh visible to the naked eye of up to 5% of the surface, a slight change of color, no peeling, bubbles, defects or surface corrosion. Table 3 shows the values of the technological and operational properties of the developed DCM facing coating.

Table 3: Properties of the Developed DCM Compositions and the Facing Coating

Indicator	The Value of the Indicator of the Composition	The Value of the Prototype *
Compressive strength, MPa	3-4	1-2,5
Adhesive strength, MPa	0,6-0,9	0,5-0,7
Frost, least n cycles	50	35
Drying time to degree "5" at (20 ± 2) ºC, min	15…20	-
Water-holding capacity, %	98-99	97
Water absorption by weight, %	10-12	11-12
Water resistance	0,68-0,74	-
Shrinkage mm/m	0,26-0,34	-
Water vapor permeability μ, mg/m•h•Pa	0,05-0,07	0,07
Consumption of facing coating when applied in one layer, kg/m^2	1-1,2	1,4-1,6
Viability, hours	1-1,5	2-3
Shelf life, months	6-12	6-12

Note: * The choise as the prototype was lime plaster composition "Kreps Antique"

CONCLUSIONS

Thus, application in a compounding of limy structures a filler based on the HSC allows to receive rather strong coverings possessing higher water resistance and durability.

REFERENCES

1. Loganina, V.I. The influence of the synthesis technology of silicate fillers on the properties of lime and finishing compositions / V.I. Loganina, L.V. Makarova, K.A. Papsheva (Sergeeva) / / Regional architecture and construction. - 2011. - № 2. - P.66-69.

2. Loganina, V.I. The properties of lime composites with silicate fillers / V.I. Loganina, L.V. Makarova, K.A Sergeyeva / / Building Materials. - 2012. - № 3. - Pp.30-35.

3. Loganina, V.I. Increasing water resistance of lime-based coatings / V.I. Loganina, L.V. Makarova, S. Kies liqin, K.A. Sergeyeva / / News of higher educational institutions. Construction in progress. - 2012. - № 1 (637). - P.41-47.

4. Loganina, V.I. The structure and properties of fine fillers based on calcium silicates for dry construction materials / V.I.Loganina, L.V. Makarova, K.A. Sergeyeva / / Bulletin of civil engineering /engineers. - 2012. - № 2 (31). - P.167-169.

5. Volzhensky A.V. Stambulko V.I., A.V. Gypsum cement pozzolanic binders and concrete products. M. Stroyizdat. 1971. 317p.

AUTHOR DETAILS

About authors Loganina Valentina - Doctor of Technical Sciences, Professor of the Federal State Budget Institution of Higher Professional Education "Penza State University of Architecture and Construction" Address: 440028 Russia, Penza, GermanaTitova street, 28. Ludmila Makarova - Ph.D., Associate Professor of the Federal State Budget Institution of Higher Professional Education "Penza State University of Architecture and Construction." Address: 440028 Russia, Penza, GermanaTitova street, 28. Tarasov Roman Viktorovich - Ph.D., Associate Professor of the Federal State Budget Institution of Higher Professional Education "Penza State University of Architecture and Construction." Address: 440028 Russia, Penza, GermanaTitova street, 28. Christine A. Sergeeva - Ph.D., Research Associate of the Federal State Budget Institution of Higher Professional Education "Penza State University of Architecture and Construction." Address: 440028 Russia, Penza, GermanaTitova street, 28.