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Construction Mortar for Plaster Works Using Fine Sands of the Chechnya Republic

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ABSTRACT

This work contains results of using failed local fine sands for construction plaster matrixes. Plaster mixes of improved technological, physical and mechanical properties were obtained. Using of complex mineral admixtures in construction mortar increases working life up to 5.5 hours, compression capacity – more than 30%, adhesion – up to 20%, decreases ability to delaminate, what widens its use in construction. It was defined that sands (hard and cold aggregate), slag, pumice stone, charcoal (light and warm aggregate) are used as aggregates. The best sand for making the plaster mortar is stream sand. It is the cleanest sand which does not need additional refining, and not decreasing resistibility of the mortar. Beach, ravine and rock sands are usually polluted by salts and clay; they should be washed before use. There are coarse (grain size from 2 to 5 mm), medium (grain size from 0.5 to 2 mm) and fine (grain size up to 0.5 mm) sands. Usually medium sands are used in plaster works, and fine sands in molding plaster for troweling and fine-grained fractures. It was showed that sharp sand is the best. It joins well with binders. Coarse sands are rarely used in plaster works. Usually medium sands are used. Fine sands are used for molding plaster which allows, while trowering, to get fine-grained finish without spackling it for painting. It was discovered that slag sand is obtained by crushing and screening of slag, which was kept in dump at least for 3 months, so all the sulfide impurities that destroy binders and decrease mortar resistibility could be washed out. These sands, being lighter sands, are used in mortar for building plastering and heat insulation. Herein, plaster thickness should not be less than 3 cm.

KEYWORDS
Construction mortar; fine sands; complex modifying admixture; mineral dust; insulation; increase.

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Introduction

Every year construction materials market widens with different building materials, including finishing composites of new generation (Cruz Jiménez et al., 2002; De Luca et al., 2015; Ferriz, 1985; Franzini et al., 2000). Nevertheless, the main basic finishing material is construction mortar mix. Its usage effectiveness tied to good sound isolation, resistibility and long working live, that allows this composite (mortar) to compete with other more modern materials.

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Materials and methods

It is widely known, that main tendency in building materials and components science is to use secondary raw materials of man-made or failed origin, usage of non-waste technologies, and imitation of natural textures in order to increase building material effectiveness, lower prime cost, and improve other factors (García Cook & Merino Carrión, 1977; 2000; Karkanas, 2007; Gao et al., 2002; Ricci Lucchi, 1980; Barca et al., 2008).

In this case, construction mortar mixes have very good isometric properties, such as ability to replace part of the binder with crushed active admixtures and usage of fillers of both natural and artificial origin, etc. (Gillot, 2014; Heiken & Wohletz, 1985; Hueda Tanabe et al., 2004; Jerram, 2001; Bakolas et al., 1995; Joyce, 2014). Usage of local man-made filler allows cutting significantly construction mortar prime price without reducing its quality (Bazhenov et al., 2011; Murtazaiev, 2009; Murtazaiev et al., 2015a; 2015b).

Thus, we know that Chechnya Republic has a great storage of fine and very fine sands. According to existing standards, their usage is permitted in limited amount, providing it does not consist of organic impurities. Coarse and medium sands, required in building materials industry, are not found on the Chechnya Republic territory. All building industry in Chechnya Republic is carried out on imported sand or washed red sand (Dvorkin et al., 1991).

Problem of coarse and medium sand lack is up-to-date in high mountain areas. All the more delivery of sand to high mountain area during winter season can be obstructed due to weather conditions (Dvorkin & Dvorkin, 2007; Lesovik et al., 2012).

Results and discussion

To exam fine sands for construction plaster mortar suitability we took Vedeno sand samples. Laboratory tests were carried out in Modern Building Materials and Techniques multiple-access technical research center at GGTNU construction department, using modern methodology and equipment. Vedeno sand grain-size and substantial analysis showed that it relates to very fine sands group with Abram's finesses modulus Fm = 1.4 and physical composition meets all requirements (tables 1 and 2).

Table 1. Vedeno sand main quality indexes

Filler's name	Sand indexes					
	Finesses modulus, Fm	Sand moisture, %	Content of dust and clay particles, %	Ave. grain density, kg/m3	Ave. bulk density, kg/m3	Void ratio of sand, %
Vedeno formation sand	1.4	19	2.2	2360	1320	17.8

Table 2. Mineral fillers physical composition

Filler's name	Composition, %								
	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	TiO_2	SO_3	Other mineral particles	Persantage of other impurities
Vedeno formation sand	78.57	6.30	1.94	2.12	3.40	0.10	0.99	4.38	2.2

Hereafter, we obtained laboratory batch composition of construction mortar and analyzed its main physical, mechanical and technological properties (table 4).

As you can see, using of Vedeno sand as filler results in a low-grade construction mortar.

To stabilize technological properties, in particular to increase working life and decrease ability to delaminate of the plaster mortar, a complex modifying admixture, developed on man-made raw material as bottom-ash mixture, was added (CMA) (table 3, 4) (Murtazaiev & Ismailova, 2008; Kuladzhi et al., 2015).

Table 3. Complex modifying admixture formula

Composition	bottom-ash mixture (BAM), %	97.0
	high-range water reducer C-3, %	3.0
Grinding fineness, sm^2/g		5000
Time of grinding, min		≈1

Table 4. CMA impact on construction mortars

Filler's name	Compression capacity, MPa	Workability, sm	Water holding capacity	Adhesion, MPa	Ability to delaminate, %	Working life, hour
Vedeno formation sand	9.8	20.0-22.0	95.2-95.8	0.46	14.8	1.0-1.2
	12.8	10.9	98.5	0.54	8.4	5.5

Conclusion

Obtained results and their analysis show that adding CMA to the construction mortar formula on Vedeno sand increases working life up to 5.5 hours, compression capacity – more than 30%, adhesion – up to 20%, decreases ability to delaminate, what widens its use in construction. Herein, technological properties are more important for plaster mortar than physical and mechanical ones. Therefore, plaster mortar on Vedeno sand with CMA can be used in finishing works. Besides, it does not bear down before standard cement-sand mortar in technological, physical and mechanical properties, and even outperform it.

Disclosure statement

No potential conflict of interest was reported by the authors.

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