Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 195 (2017) 189 – 196

Procedia Engineering

www.elsevier.com/locate/procedia

18th International Conference on Rehabilitation and Reconstruction of Buildings 2016, CRRB 2016

Damage to Polymer Coating on Facing Brick Surface in Operated Buildings

Iuliia Ginchitskaia[a], Grigory Yakovlev[a]*, Olga Kizinievich[b], Irina Polyanskikh[a], Grigory Pervushin[a], Polina Taybakhtina[a], Iuliia Balobanova[a]

[a]*Faculty of Civil Engineering, Izhevsk State Technical University, Izhevsk, Studencheskaya St., 7, Russia,*
[b]*Faculty of Civil Engineering, Vilnius Gediminas Technical University, Vilnius, Sauletekio al., 11, Lithuania*

Abstract

The article describes the main reasons of efflorescence on the facing brick surface coated with polymer that leads to its delamination in operated buildings. To reduce efflorescence moisture, infiltration in the masonry should be reduced, the rate of which depends on the capillary porous structure of bricks. To control the porosity, building ceramic is suggested to be modified with multi-walled carbon nanotubes dispersions of Graphistrength CW 2-45, which enhances the structure of adobe, improves its sintering, increases the structure uniformity of ceramic fragments and efflorescence resistance. Ceramic matrix of the modified samples before and after firing has a dense and uniform microstructure with the minimum of deep interconnected pores. Adding carbon nanotubes in the amount of 0,001 % from the formed mass provides the modification of the ceramic matrix and improves its physical and mechanical properties by 30-35 %.

Peer-review under responsibility of the organizing committee of the 18th International Conference on Rehabilitation and Reconstruction of Buildings 2016

Keywords: efflorescence; ceramic bricks; polymer coating; multi-walled carbon nanotubes; nanomodification

---

* Corresponding author. Tel.:+7-912-856-6688.
E-mail address: gyakov@istu.ru

Peer-review under responsibility of the organizing committee of the 18th International Conference on Rehabilitation and Reconstruction of Buildings 2016
doi:10.1016/j.proeng.2017.04.543

1. Introduction

Studying efflorescence processes on brick facades of the buildings under construction and the operated ones as well as its prevention has always been important in the construction industry. Currently, the focus of attention is on efflorescence on ceramic brick coated with thermoplastic polymer paint, where efflorescence not only spoils its appearance, but can also lead to the damage to polymer coating.

Efflorescence on brickwork appears depending on the salt content in both brick and mortar and the environmental parameters, including humidity, temperature, and chemical composition [1]. The intensity of efflorescence can also be associated with the pore size and their volume in ceramics, because the migration of soluble salts is due to its capillary porous structure. It is known [2] that, the pore diameter being 30-400 nm, the equilibrium moisture content reaches its maximum in the range of the pore size above 300 nm. Also, the capillary effect intensifies, the pore size increasing. At the same time, the structure with the pores in the range of 30-300 nm increases the specific surface area, which provides longer diffusion path of water with dissolved salts due to the forced rounding of the pore structure [3]. As a result, the concentration of dissolved salts on brick surface is minimized, which prevents efflorescence formation. Researchers [4] show that the increased migration of solutions through brickwork is associated with large pores with the diameter exceeding 1 micron. Thus, the directed change of the porous brick structure decreasing the number of large pores reduces efflorescence on masonry surface.

One of the ways to modify the ceramic matrix is using various admixtures, including nanoparticles [5, 6]. In the scientific literature, there is evidence that adding carbon nanotubes improves ceramics sintering and increases its structure uniformity [7, 8, 9]. Furthermore, some authors have proved that carbon nanotubes limit the grain growth during sintering, contributing to the formation of a fine-grained ceramic matrix [10, 11].

This article describes the main reasons of efflorescence on the polymer coating of ceramic brick and also offers the solution. It is assumed that modifying building ceramics with the dispersions of Graphistrength CW 2-45 multi-walled carbon nanotubes (MWCNTs) enhances the sintering behavior of fragments and the uniformity of the ceramic matrix structure.

2. Materials and methods

2.1. Preparing samples

The study focuses on the masonry from M125 facing brick with polyester-based polymer coating. This coating is applied by spraying powder paint on the fired brick surface in a heat chamber.

To study the effect of MWCNTs on the properties and structure of building ceramics a ceramic batch similar to the industrial mix was used. The batch consists of 70 % of low-melting clay containing 13,33-16,10 % of aluminum and titanium oxides, and 30 % of quartz sand. The nano-admixture used is Graphistrength CW 2-45 MWCNTs (Arkema, France), the average diameter being 10-15 nm and the length of 10-15 µm. For the uniform distribution of nanoparticles, two types of aqueous MWCNT dispersions were produced in a high speed homogenizer: dispersion 1 was not exposed to ultrasonic treatment; dispersion 2 was put through sonication. The dispersity analysis conducted with CILAS 1090 Liquid instrument showed that after 21 days of storage the average particle diameter in dispersion 1 is 2,53 microns, and in dispersion 2 - 0,65 microns. MWCNTs were added to the batch in the amount of 0,001 % and 0,009 % from the clay mass with water for moistening up to 21,85 – 22,85 % mixing water content. The molded samples were dried at 20 ± 5 °C for 2 days and at 105 °C for 1 day in a chamber drier. After drying, the samples were fired with the isothermal time of an hour at the maximum firing temperature of 950 °C and 1000 °C.

2.2. Analysis methods

The macrostructure of the samples was studied with AM4113ZT Dino-Lite Pro Polarizer USB-microscope. The microstructure analysis was conducted with PHENOM G2 Pure and Quanta 250 (FEI Company) scanning electron microscopes. IR spectra were obtained using SpektrumOne, a Fourier transform infrared spectrometer in the frequency range of 4000-400 cm^{-1}.