Efficiency of the Modifiers Use for Protection of Brick Structures

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Abstract – The problem of increasing the operational properties of brick for external walls is considered in the article. Bricks were modified by different types of water-repellents. The surface modification of ceramic facing brick by hydrophobic nano-liquid provides to reduction of the capillary suction of the masonry.

Keywords – ceramic facing brick, water absorption, surface modification.

Introduction

The main factors that affect on the durability of structures and buildings are aggressive environmental factors. Most brick walls are porous and over time can be vulnerable to damp penetration [1]. Prevent damp on brick walls and masonry it is advisable to apply a brick wall coating. The brick wall coating will act as brick water proofer and help prevent water ingress which causes damp [2]. To improve the performance properties and increase the durability of the brick masonry is widely used a surface treatment method by hydrophobic substances [3]. Different classes of synthetic organic coatings have been used or tried for this purpose. These coatings are very efficient to repel water and provide a very hydrophobic surface but are expensive and require complex application conditions. The indicators of the coating destruction are their cracking, detachment, loss of mass and color. At the same time, mechanical, physic and chemical, anticorrosive properties also change, which can lead to loss of protective [4]. Recently, the potential of nanotechnology application in building is growing. Nano-liquids that reduce water absorption, permeability coefficient and increase the impermeability of structures are used to effectively protect surfaces on the nano- and micro-level [5]. In the present article we study the possible use of nano-liquid on bricks as hydrophobic barrier and water repellent coating.

Materials and methods

Ceramic facing brick ASTM C-216, Grade MW, Type FBS, Average compressive strength 16.81 MPa (EN 771-1:2003) and clinker facing brick ASTM C-216, Grade SM, Type FBX, Average compressive strength 32.3 MPa are used for investigation. Hydrophobic substances based on silicon organic compounds KO-85 (SOC), acrylic polymers (HS 1) and water-repellent of penetrating complex action with the content of nanoparticles - nano-liquids (HS 2) are used for surface modification of ceramic facing brick.

Water absorption at capillary suction is determined by water volume at atmospheric pressure at the expense of capillary or adsorption forces. The hydrophobic properties of the modified bricks were evaluated monitoring the time taken for a droplet to penetrate in the brick through the coating.

Results of investigation

Experimental studies have found that, porosity of ceramic clinker bricks is 13.6 %, water absorption – 5.2%, water absorption at capillary suction – 0.5 $kg/m^2 \cdot hour^{0,5}$. In this case, the ceramic facing brick is characterized by high porosity (21 %) and water absorption (16.5 %). The rate of water absorption at capillary suction reaches a value of 2.2 $kg/m^2 \cdot hour^{0,5}$, which is in 4.4

times more compared with clinker bricks. The studies of the efflorescence formation have established the presence of efflorescence's on the ceramic facing bricks surface after 7 days of testing.

Surface modification method by hydrophobic substances is used for the protection of structures and improvement of the operational properties of ceramic facing bricks. Surface modification of ceramic facing brick by silicon-organic compounds KO-85 decreases water absorption from 16.5 % to 13.2 %. The use of water-repellents based on acrylic polymers (HS 1) decreases porosity in 1.3 ... 1.4 times, water absorption - to 30 %, the rate of water absorption at capillary suction – in 2 times. Surface modification by a water-repellent of penetrating complex action with the content of nanoparticles (HS 2) decreases water absorption from 16.5 % to 5.1 %, the rate of water absorption at capillary suction – in 3.8 times (from 2.2 to 0.58 $kg/m^2 \cdot hour^{0,5}$), which ensures the achievement of the clinker bricks indicator.

Surface protection by nano-liquid of hydrophobic action decreases porosity, water absorption at capillary suction, increases water resistance and efflorescence resistance of the structures. The nano-liquid is an invisible water-resistant barrier to brickwork and masonry. An application of nano-liquid slows down the spread of efflorescence's. Nano-liquid works by filling in the porous voids in the bricks or masonry at a microscopic level. It is water-vapor permeable and will not trap any retained moisture in the substrate. The coated bricks display high hydrophobicity which could, reduce water absorption in outdoor usage.

Conclusion

The masonry modification by chemical active substances provides the necessary hydrophobicity and resistance to penetration of moisture due to commutation of pores and cracks in the surface, which increases its impermeability and resistance to the effects of environmental factors. It is provided the decreasing of porosity, water absorption at capillary suction, increasing of impermeability and efflorescence resistance of structures is provided by protecting the surface of brick with hydrophobic substances and nano-liquids.

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