The Influence of Injection Agents Applied for Carrying out Secondary Horizontal Damp Proof Courses on Masonry Mortar Properties

Tomasz Błaszczyński¹, Barbara Ksit² and Bartosz Monczynski³

¹ 62-002 Złotniki, Poland, tomasz.blaszczynski@opal.info.pl
² Poznan University of Technology, 60-965 Poznań, Poland, barbara.ksit@put.poznan.pl
³ Remmers Polska, ul. Sowia 8, 62-080 Tarnowo Podgórne, Poland

Keywords: Injection, Damp Course, Renovation, Dampening.

1 Introduction

A cement-lime mortar with a volumetric composition of 2:0, 5:8 (hydrated lime: CEM I 32.5 Portland cement: sand with a granulation of 0-2 mm). The fresh mortar was placed in a mould made from PVC pipes 200 mm in diameter, cut in 300 mm sections. After the initial hardening of the mortar, that is two days after preparing the moulds, the samples were placed in polyethylene bags for another five days. After a period necessary for the mortar to reach full strength, it was subjected to dampening, placing the moulds in a tray with water (on a grate) so that the samples were constantly submerged in approximately 10 mm. After two days, the moulds were taken out of the water, wrapped in foil and left for two weeks in order to ensure even distribution of moisture in the mortar. Holes were made in the samples and gravitational injection, using an injection cream, and pressure injection (under a pressure of 0.2 MPa increased after 30 s to 0.5 MPa) using methyl silicates as well as silicone microemulsion (SMK), carried out. After a further four weeks, the mortar was taken out of its moulds and cut using a circular saw into cubic samples with sides measuring approx. 45 mm.

2 Results

Studies on absorbability were carried out on twenty-four cubic samples which, after drying at a temperature of 105±5°C and weighing, were placed in a tub, on a grate, and then submerged in water to approximately a quarter of their height. After 24 hours, that is after the completion of sample dampening as a result of capillary rise the samples were submerged to half their height and, following another 3 hours, to three-quarters of their height. The complete submersion of samples (minimum of 20 mm above the upper edge of the samples) took place 30 h after the commencement of the experiment. After complete impregnation, the samples were removed from water, dried with a rag and weighed.

The results of studies on absorbability and capillary rise have been presented in Table 1. The compression test was carried out in an Instron 8500 Plus testing machine. Forty cubic samples were used for the tests. The applied load was controlled by a force of 50 N/s – this value was selected so that the compression test of an individual sample would fall in the range of 30 to 90s. Due to the irregular shape of the samples, they underwent evening/smoothing with 220 grit sanding mesh. Determining the resistance to frost is carried out by determining the mass loss caused by periodic freezing and thawing. Twenty-four samples were prepared for the test.

The samples were marked as follows:
- MKA – mortar impregnated with alkaline methyl silicate,
- SMK – mortar impregnated with silicone microemulsion,
- KI – mortar impregnated with injection cream,
- 0 – mortar lacking impregnation (controls).
Table 1. Results of studies on capillary rise and absorbability.

<table>
<thead>
<tr>
<th></th>
<th>m1</th>
<th>m3</th>
<th>m6</th>
<th>m24</th>
<th>w24</th>
<th>nm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>11.7%</td>
<td>11.8%</td>
<td>11.8%</td>
<td>11.9%</td>
<td>1.89</td>
<td>11.8%</td>
</tr>
<tr>
<td>MKA</td>
<td>12.0%</td>
<td>12.1%</td>
<td>12.2%</td>
<td>12.3%</td>
<td>1.93</td>
<td>12.0%</td>
</tr>
<tr>
<td>SMK</td>
<td>11.5%</td>
<td>11.7%</td>
<td>11.7%</td>
<td>11.9%</td>
<td>1.87</td>
<td>12.0%</td>
</tr>
<tr>
<td>KI</td>
<td>7.8%</td>
<td>8.0%</td>
<td>8.1%</td>
<td>8.4%</td>
<td>1.35</td>
<td>10.2%</td>
</tr>
</tbody>
</table>

Testing the resistance to the crystallization of salts was carried out on twenty-four cubic samples which, after drying and weighing, were placed for 2 h in 14% solution of sodium sulphatedecahydrate (Na₂SO₄·10 H₂O). Next, the samples were dried at a temperature of 105 ±5°C for a minimum of 16 h. In order to ensure high air humidity at the first stage of drying, a tray containing water was placed in the dryer prior to its initiation. After completion of the drying process, the samples were cooled for approx. 2 h to room temperature and once again submerged in a saline solution.

Impregnation of mortar was carried out with dampness resulting from close to maximal capillary rise of water. The results of studies on the capillary rise of water and total absorbability confirm that a high level of dampness makes it difficult or even impossible to apply agents based on alkaline methyl silicates and silicone micro emulsion. Injection creams, on the other hand, work very well in such cases (an over 13% reduction in total absorbability and nearly 29% decrease the capillary absorption coefficient were observed). All analyzed injection agents had a beneficial effect on the compressive strength as well as resistance to the harmful effects of construction salts. Alkaline Methyl silicates caused an increase in freeze-thaw resistance of the mortar. Due to the fact that the mortar subjected to the effects of agents based solely on hydrophobisation (silicone microemulsion and injection creams) caused a decrease in resistance to freezing and thawing, these substances should not be applied if there is no possibility to dry the wall before winter and it is not protected against freezing.

The results of the carried out studies also confirm that chemical injection treatment of the wall should not be carried out without accounting for specific conditions, such as the level of dampness, the location of the wall, conditions of the surroundings, etc. It should also be kept in mind that walls are conglomerates comprising materials characterized by various technical parameters.

ORCID

Tomasz Błaszczyński: http://orcid.org/0000-0003-3177-9654
Barbara Ksit: http://orcid.org/0000-0001-6459-8783
Bartłomiej Monczynski: http://orcid.org/0000-0002-6847-3854

References