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Original article

New test methods to verify the performance of chemical injections to deal with rising damp

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ABSTRACT

The injection of chemical products, meant to penetrate in the capillaries of the materials composing an affected wall, is perhaps the most diffused method to deal with rising damp. The majority of these chemical products are hydrophobic treatments; they can be either solvent-based or (increasingly) water-based. Traditionally, these products are liquid. In the last years however, a tendency towards the use of cream-like products can be observed. From practice, quite contradictory opinions arrive with respect to the effectiveness of injections and quite often disputes develop between building owner and executing contractor on the performance of the treatment. Sometimes the slow drying of humid walls is used to cover a failing treatment; in other cases, it is not clear whether the injection or a simultaneously applied restoration plaster is responsible for a visual improvement. Research was performed in order to establish a method to evaluate the effectiveness of injection methods in a simple and quick way, both for assessing performance in practice and for use in laboratory. Interesting side effect of the research program was that also several essential parameters, influencing the effectiveness of chemical products, became evident. In this article, focus will be on the quick assessment method for practice.

1. Introduction

1.1. Injection and impregnation with chemical products

Many methods exist to deal with capillary rising damp. In spite of the large quantity of methods and products, scientific literature on their effectiveness, in laboratory and in the field, is rather scarce [1].

Injection and impregnation with chemical products is one of the most commonly used methods to tackle rising damp problems in buildings. It consists in drilling holes in the wall along a horizontal profile, at a distance of usually 0.1 to 0.15 m. The holes can be drilled from one side only or from two sides of the masonry, mainly depending on the wall thickness.

The chemical products can be either introduced with pressure (injection) or without (impregnation, with the use of hydrostatic pressure). Chemical products can work by filling the pores (and thus creating an impermeable layer in the masonry) and/or by making the pores water repellent, thereby inhibiting capillary transport. Nowadays, most of the products present on the market rely on the last working principle.

The products can have an organic solvent or be aqueous solutions or emulsions in water. In the last years, there is a tendency towards water-based products, as they are more environment and user friendly. Products with different viscosities exist, from liquid to cream and gels; cream products are gaining more and more importance in the last years, most probably because of their greater ease of application.

There are several problems related to the application and the effectiveness of chemical products. One of these is the difficulty of introducing the product in pores, which are for a large part filled with water. Some products seem to be more suitable for use on wet walls than others. This problem was extensively described in [2].

In order to be effective, the chemical product should reach all pores and voids and create a hydrophobic or impermeable horizontal layer, which does not allow the water to go through. If this horizontal barrier is not continuous, water can still go through and rising damp will not be stopped. The injection or impregnation should therefore be performed in such a way that the treated zones overlap each other.

From practice, quite contradictory opinions arrive with respect to the effectiveness [3] and often disputes arise between building owner and contractor that performed the work. The slow drying of

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Fig. 1. Exterior (left) and interior (right) of the wing in the St. Bernardus Abbey in Hemiksem (Belgium).

humid walls can be used to cover a failing treatment; sometimes it is not clear whether a visual improvement is due to the injection or to a simultaneously applied restoration plaster. Research was performed in order to establish a method for the evaluation of the effectiveness of injection methods in a quick and simple way, both for practice and for laboratory. Internationally different procedures exist for the evaluation of injection products in laboratory [4–7].

The aim of the research was to develop a method for the evaluation of the effectiveness of chemical products in a reliable way, within a short time from their application. Two closely related new methods, one for the evaluation of the effectiveness of injection products in laboratory, and another for the evaluation of the effectiveness of products when applied in practice, were developed. The laboratory method is described in [2,8] and [11]. Here the quick practice method, which for a part is derived from the laboratory method, will be discussed.

1.2. Test methods for the assessment of the effectiveness of chemical injections in practice

A proven method to obtain reliable data on moisture and salt content is to drill powder samples from the wall at different depths and heights, along a vertical profile. Subsequently, moisture (MC) and hygroscopic moisture content (HMC) can be determined gravimetrically. The hygroscopic moisture content gives a reliable indication of the presence of hygroscopic salts [9]. Based on the comparison between the MC and HMC curves, the presence of rising damp can be assessed (see also [10], in this special issue).

This procedure is initially performed to assess the presence of rising damp and can be repeated one or two years after treatment in order to follow the drying process. It will be clear that in case of doubt or conflict such a long lasting method it not very favorable.

Therefore a quick method has been developed that is derived from the quick laboratory test as described in [8]. The method includes taking drilled core samples (diameter 10 cm) and powder samples from the treated zone short time (few weeks) after injection has been carried out. Because of its intrusive character, this method should be used with care in case of historic buildings with monumental value.

The test on cores consists of several steps and has, for most injection products, an expected duration of 7 to 8 weeks, starting from the moment of injection.

The method and its application on a case study are discussed in this paper.

2. Test site and products used

2.1. Selected site

Sint Bernardus Abbey in Hemiksem (Belgium) was selected for the validation of the test (Fig. 1).

A perimetral wall facing the courtyard of the Abbey was selected for injection. This location is very suitable for the assessment of the effectiveness of the injection products and the validation of the test methods, since there is a clear problem of rising damp (see Section 3.3). Moreover, the long masonry wall offers the possibility of testing different chemical products in the same wall, thus in very similar materials and exposure conditions, facilitating the comparison.

2.2. Selected products

Four products were selected for injection in the wall of the abbey in Hemiksem. The products represent the main classes of products identified in a market research. The selection includes water-based as well as a product in organic solvent, liquid products as well as a cream:

- C2: siliconate (potassium methylsiliconate; % active component not specified) in water, liquid;
- B3: siloxane (oligomeric siloxane; active component about 10 wt%) in organic solvent (isoparaffin), liquid;
- B2: siloxane (no further indication provided) in water, liquid;
- E5: silane (no further indication provided; active component ca. 80 Wt%), cream.

It should be underlined that manufacturers often only provide limited information on molecular structure, type of solvents and presence of additives, whereas such information is considered important to enhance general scientific knowledge. Unfortunately a cultural gap seems still to be filled in this respect.

The working principle of all products relies on making the pores water repellent, thus hindering capillary transport of water.

2.3. Starting situation

On the wall facing the courtyard six locations were selected for the application: 2 reference locations and 4 locations for injection of the products. Before injection, a moisture profile was determined for every location, in order to have insight in the start situation. Fig. 2 shows the 6 locations: the red dotted lines indicate the location of the moisture profile, the black dots the location of the injections.

Moisture and hygroscopic moisture profiles were obtained for each location before injection; a representative example (location 5) of the profiles for brick and mortar, is presented in Fig. 3. The profiles clearly show the presence of rising damp in the wall. The amount of hygroscopic salts is low, as shown by the low HMC measured.

2.4. Injection of the wall test panels

The products were injected in the areas as indicated in Fig. 2. No space was left between one injected area and the adjacent one; in this way it was not necessary to inject an additional vertical line of holes to separate treated and untreated areas. The length of the

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