Water Repellent Treatment of Building Materials
Proceedings of Hydrophobe II
Zürich, September 1998, Aedificatio Publishers pp.189-196

Treatment of Rising Damp with Hydrophobic Agents in Wet Conditions

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Abstract

One aim of the investigations was to study the effectiveness of market products for the treatment of rising damp. Especially water saturated masonry has to be considered. The other aim was to develop an effective method to prove the effectiveness of this injection material for the treatment of rising damp in laboratory conditions.

The developed test method and the corresponding maximum evaporation rate (100 g/($m^2 \cdot d$)) are able to determine the functionality of drill hole injection systems for installation of damp courses against rising damp. The results show that all investigated injection materials do not work properly on water satured bricks.

Keywords: rising damp, drill hole injection systems

1 Introduction

Masonry with non effective or without damp courses is often damaged by rising damp or salts in the basement. These damages become visible by defective plaster, coatings and joint mortar and also crystallizated salts on the masonry surface.

Applications available on the market for the treatment of rising damp are based on mechanical, electrophysical and chemical principles. In compliance with the financial aspect, the chemical drill hole injection system is one of the most interesting application systems.

Because of problems this system has had especially on water saturated brick masonry it was necessary to create a special research programme [1].

The aim of the investigations was to study the effectiveness of market products for the treatment of rising damp. Especially water saturated substrates have to be considered. The other aim was to develop an effective method to prove the effectiveness of this injection material for the treatment of rising damp.

2 Investigations

2.1 General Remarks

Based on comfortable indoor conditions a limit for the maximum water vapour quantity could be found. For damp courses this value is about 100 g/ $(m^2 \cdot d)$.

In German literature you can find a lot of objects which have high degrees of saturation in the area of damp courses. Often you can find degrees of saturation up to 100 % in many objects and the surface of such wet brick masonry is nearly dry [1].

The manufacturers of injection products give no or not enough information on the applicability. Normally they don´t give any information about the chemical composition of their products. These are the results of a published market analysis, which was analysed in advance of the laboratory investigations [2].

2.2 General Plan and Sample Preparation

Two of totally 20 different bricks were selected by determinating the water uptake behaviour and the density. For this decision the water uptake coefficient and the injection behaviour of each type of brick was taken into account. One of the selected bricks, which is still available on the market (marking: Z13), has a very high density and the other one is a historical brick (about 100 years old) with a very inhomogeneous pore system (marking: Z15).

Together with the injection material industry and in compliance with the result of investigations made at the Institute for Building Research 5 different injection products (based on hydrophob agents) were selected [1]. The following table shows these selections, their active substance and mode of action. The product specific information was given by the producers codes of practice.

To select a real water content for the application the specific bibliography and our own object experience were taken into account. So the test specimens (bricks) were water saturated before the application was carried out with a pressure of about 6 bar. This takes about 1 min to 5 min for each brick application. For every application, we use the information of the maximum water uptake to calculate the needed application volume.

After a water storage of 48 d (temperature of 23° C) the test specimens were prepared for the effectiveness test (s. Figure 2). The evaporation rates were determined for the test specimen slices „T 2.1“ and „T 2.2“. They belong to a mean drill hole distance of about 7 cm. The evaporation rates were

Table 1: Selected injection materials

Name	Description	mode of action
1	2	3
IS 3	silicate-based	narrowing/hydrophobic
IS 4	KSE-based	narrowing/hydrophobic
IS 6	silicone-microemulsion	hydrophobic
IS 8	KSE-based (water based)	hydrophobic
IS 9	building market (no information about details)	hydrophobic

determined by weighing the whole prepared test system and measured in g/ (m^2 h). During the determination of the evaporation rates the test specimens were stored with one side in water. Stationary conditions could be evaluated after a test period of about 10 days. The following table shows the varied investigation parameters

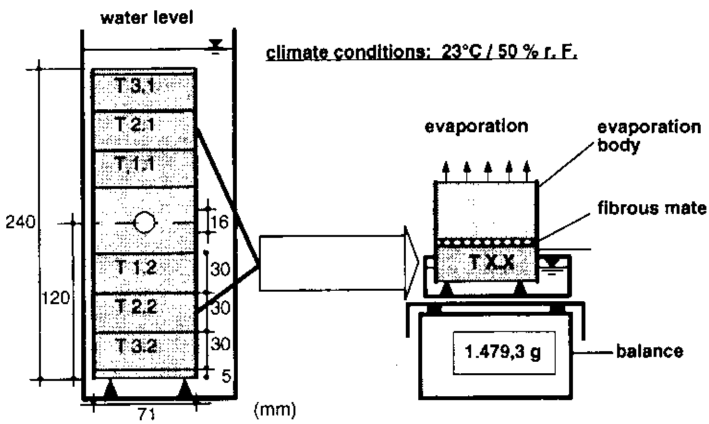

Figure 1: evaporation rate determination

Table 2: varied investigation parameters

parameters	**varied parameters**				
substrate	new brick Z13			historical brick Z 15	
test conditions (before injection)	water saturated				
injection materials	IS 3	IS 4	IS 6	IS 8	IS 9
injection pressure	6 bar				
test conditions (after injection)	storage 48 h under water				
evaporation rate determination	1. water saturation	1. drying and 2. water saturation	2. drying and 3. water saturation		
series	I	II	III		

After the series I the test specimens were dried for 4 weeks. Next „ground water lowering" simulation series II was realized. Series III follows in the same way.

3 Results and discussion

In the specific literature a limiting value for the maximum allowable evaporation rate could not be found. A permissible value for a maximum evaporation rate could be found by using a simple model and some calculations. We answered the question - how much moisture could be substituted by an ordinary number of air changes (that means $ß = 1^{-h}$) in a model room which has a volume of about $4 \times 4 \times 2.5\ m^3 = 40\ m^3$. We considered the comfortable climate conditions for inner rooms and calculated the maximum evaporation rate [3]. It resulted in about 100 $g/(m^2 \cdot d)$ [1]. We used this maximum evaporation rate for further evaluation of the laboratory test results.

Because of missing detailed information about the chemical composition of each injection product, an agent specific discussion of the results is not possible.

The following figures show the results of the series I and series III. The results of the series II are approximately the same as the results of the series III.

The results show, that the tested products did not have any chance to reduce rising damp if they are working constantly in water saturated conditions. The hydrophobic effect only functioned when there was a sufficiently long period after application of water saturated bricks. The penetrated pore system becomes hydrophobic and the evaporation rates went down. But these are ideal conditions. A ground water lowering process or something that has the same drying effect can not be expected usually.

Other results show that pressure injected materials on water saturated substrates replace just a part of the pore water [4]. A thin water layer adheres to the pore surfaces and could not be replaced by the injection material. Because of this fact the hydrophobic agents are not able to contact the pore surface. During a drying process the water went off and some hydrophobic particles install the water repellent volume with little defects because of the handicapped building process during the water saturated period. The pore system and injection material specific evaporation rates (Figure 3) show this effect. The evaporation rate reduction of any injection material is usually not

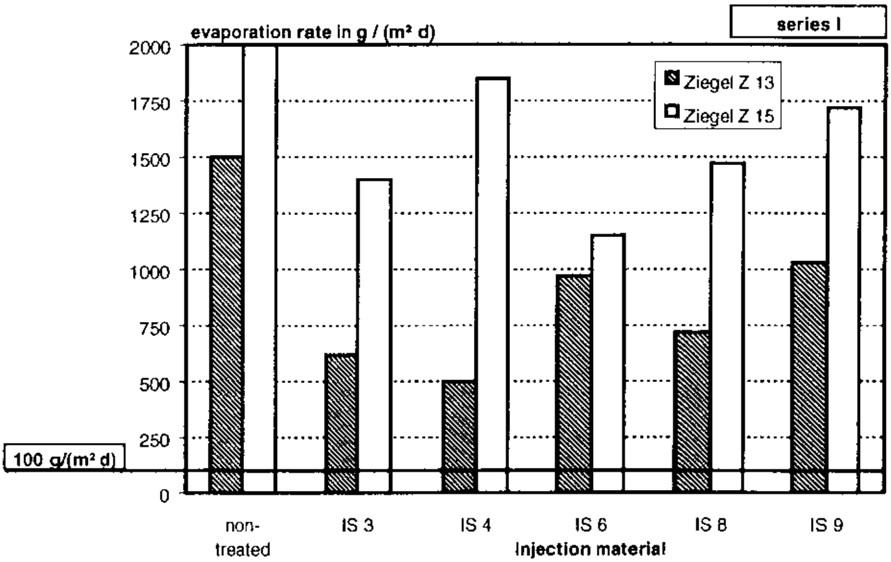

Figure 2: Evaporation rates - series I (stationary conditions)

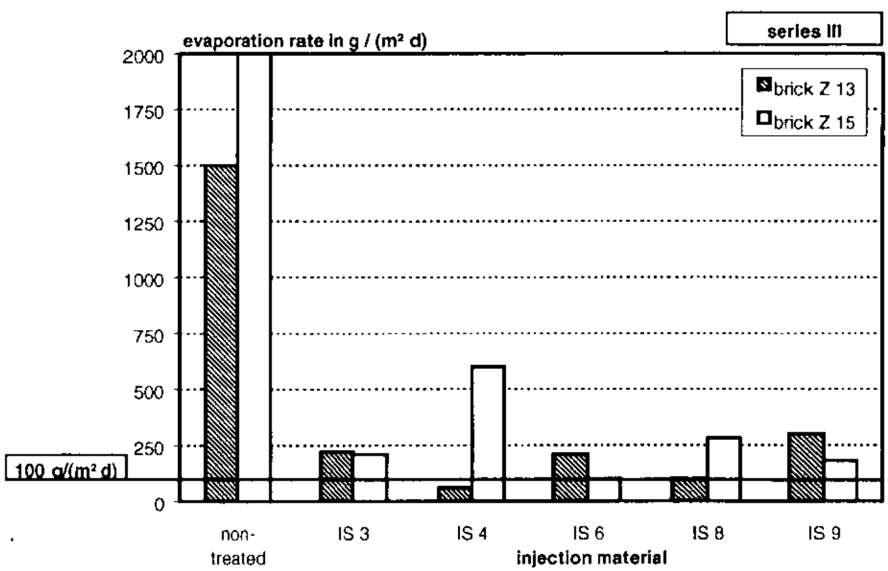

Figure 3: Evaporation rates - series I (stationary conditions)

sufficient to install a secure damp course in complex brick pore systems. In real conditions you can find bricks like Z 13 or Z 15 next to each other.

4 Summary

Masonry with non effective or without damp courses is often damaged by rising damp or salts in the basement. In compliance with the financial aspect the chemical drill hole injection system is one of the most interesting application systems.

One aim of the investigations was to study the effectiveness of market products for the treatment of rising damp. Especially water saturated masonry has to be considered. The other aim was to develope an effective method to prove the effectiveness of this injection material for the treatment of rising damp in laboratory conditions.

Together with the injection material industry and in compliance with the result of investigations made at the Institute for Building Research 5 different injection products (hydrophobic agents) and 2 different brick varieties were selected.

The test specimens (bricks) were water saturated before application was carried out with a pressure of about 6 bar.

The developed test method and the corresponding maximum evaporation rate (100 $g/(m^2 \cdot d)$) are able to determine the functionality of drill hole injection systems for installation of damp courses against rising damp.

The results of the developed effectiveness test show that all investigated injection materials do not work properly on water satured bricks. Only after a drying period (e. g. ground water lowering in practice) some products are able to install a satisfactorily damp course.

In further investigations it is necessary to get information about the water content of the substrate which allows the tested products to function in a proper way. The other way is to look for new products which are able to install an effective damp course even in water saturated pore systems. We are still working in this field and we got first interesting results. But we're just at the beginning.

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