NEW SILOXANE WATER REPELLENT TECHNOLOGY FOR THE TREATMENT OF RISING DAMP

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ABSTRACT

The use of water repellents, both silicone and organic, in the treatment of rising damp in buildings without damp proof courses has been in operation for over 25 years. The majority of the current products used as damp proof injection fluids are either highly alkaline or contain solvents.

The ideal material for this application is a water soluble siloxane that is stable in solution and able to react with typical masonry substrates.

Recently Dow Corning has developed a clear, water soluble siloxane that imparts good water repellency properties to masonry substrates.

In this paper the rate of injection of solutions of this siloxane into a "standard" substrate has been measured as well as its ability to travel through the substrate.

The water repellency performance of the treated substrate in a damp proof type application is evaluated with promising results.

An extension of this work also looks at the performance of this siloxane technology as a surface treatment water repellent.

1 INTRODUCTION

The use of masonry water repellents (**MWR's**), both siloxane and organic, in the treatment of rising damp in buildings without damp proof courses has been in operation for about 25 years.

For the majority of this time the MWRs used have been water soluble siliconates, solvented stearates and siloxanes.

The most common method of developing a water based product is to create an emulsion, which is normally a milky white to hazy blue liquid depending on the sizeof the emulsified particle. Recent efforts in water repellent technology at Dow Corning have centred on the development of aqueous siloxane solutions rather than emulsions. Work in this area has resulted in a water soluble product that has

been shown to have good performance in an injected Damp proof Course (DPC) application. Additionally the technology offers further benefits in that it is odourless, non-caustic and forms stable solutions in water.

This presentation will discuss the merits of this material in DPC applications. The topics covered will include;

1. Why are DPCs necessary
2. What are the criteria of a good DPC.
3. Legislation
4. Performance of the new material in DPC applications.

2 WHY ARE DPCS NECESSARY IN BUILDINGS

Apart from condensation, rising damp is the most common form of dampness encountered in buildings. Rising damp is the vertical flow of water up through the pores in masonry, mortar being the common link up through the wall, leading to poor aesthetic qualities.
To prevent this from happening both bricks and mortar need to be impervious to water. This can be achieved by injecting a chemical damp proof course into the bricks thus forming a water barrier layer.

Any material used as a Damp Proof Course must meet certain criteria as outlined below.

A) It must be easy to inject and diffuse through the injected brick.

B) The material should form a DPC at the point of injection, i.e., it is substantive and does not migrate up through the wall of bricks.

C) The water repellent should also act on mortar so that a continuous DPC is formed.

D) The treatment should last the life-time of the building being treated. Generally, however, companies involved in this type of work give guarantees ranging from 10 to 30 years.

3 DEVELOPMENTS

Dow Corning has developed a new material that is both soluble in water forming clear stable solutions and stable for up to 12 months. This material has been shown to give good water repellency to masonry substrates and good performance in injected DPC applications.

The results from DPC evaluations are very promising.

4 PERFORMANCE OF WATER REPELLENTS IN DPC APPLICATIONS.

The injected DPC must have the ability to prevent the uptake of water through the pores in the bricks. The treatment should also be durable.

The first criteria to be tested was the ease of injection of the material in the substrates.

a) EASE OF INJECTION

The rate of injection of solutions of DPC material in to the bricks is an important criteria. It is also important that the material diffuses throughout the brick readily.

To evaluate this Severn Valley Red Bricks, which are standard bricks used in the industry, were injected with a solution of the material. The time taken to fully saturate the bricks was recorded and compared to that of pure water. The results are shown in the following table.

All bricks were injected at 50psi for 10 minutes, weighed and injected for a further 5 minutes when no further weight increase occurred. It took 10 minutes to fully saturate the bricks with both water and water repellent solution. The percentage weight increase for both water injected and DPC injected bricks was similar at approximatelty 12wt%. Comparing the rates of injection for solutions of the siloxane to that of water alone indicates that the injection rate is dependent on the injection rate of water (TABLE 1).

TABLE 1
INJECTION RATES FOR SEVERN VALLEY RED BRICKS

n = 6	Water	Aqueous Siloxane
Initial Weight (g)	2184 +/- 19	2179 +/- 12
Weight Increase (g) 10 minutes	266 +/- 21	256 +/- 23
Weight Increase (g) Total 15 minutes	0	0
% Weight Increase	12.2 +/- 1.0	11.7 +/- 1.0

To further confirm that the water repellent had indeed diffused through the injected bricks treated and untreated bricks were cut in half and tested with

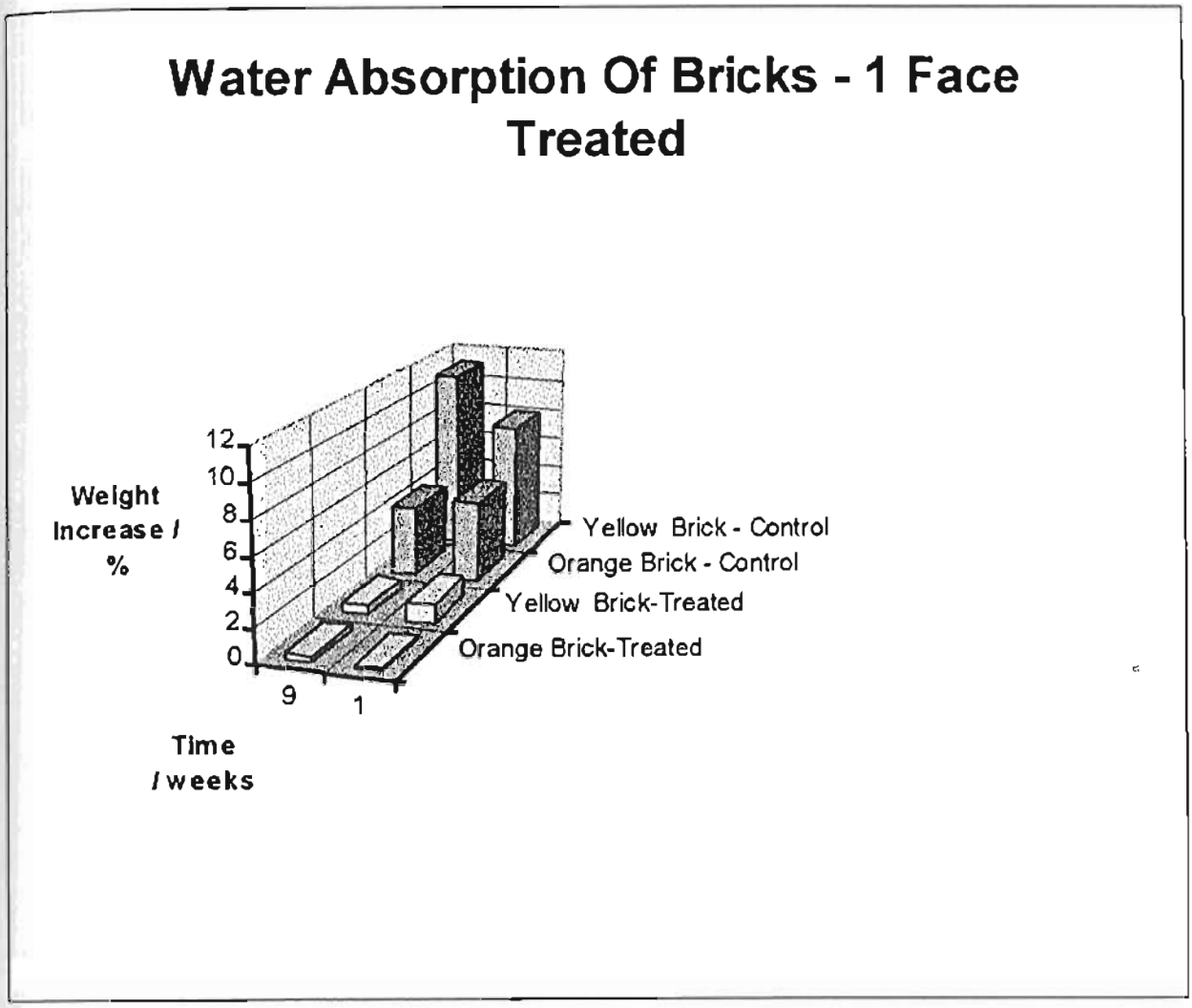
congo red dye. The dye wet out on the untreated brick but did not stain the treated brick indicating that the whole brick repelled water.

b) The second criteria for a good DPC material is that it must form at the point of injection - i.e. it must not be carried up the wall by water already present in the bricks. Therefore the injected material must cure fast enough so that this will not happen but slow enough that it will diffuse thoroughly enough in a wet wall. If the cure is slow there is the danger that the DPC will form above the point of injection.

To determine this one face only of two different types of brick (yellow and orange) with varying pore size and surface quality were treated.

One face of the bricks was dipped in a solution of the water repellent for 15 seconds. The water repellency performance of the treated and untreated bricks were tested by gravimetric tests for 1 hour over a 2 month period.
The results are shown in Graph 1. Both the untreated bricks absorb significant amounts of water but over the time period studied neither of the treated bricks did. This test indicates that a) the material gives a good water repellent surface and b) it is not washed out during immersion in water and cures to the substrate at point of application.
As no change in performance was noted over the 2 month period this confirms the fact that the water repellent cured to the substrate and does not migrate through the brick. This cure or bonding is made possible by the virtue of the silanol and organofunctional groups present which cure to the brick.
The results of this test are shown in graph 1.

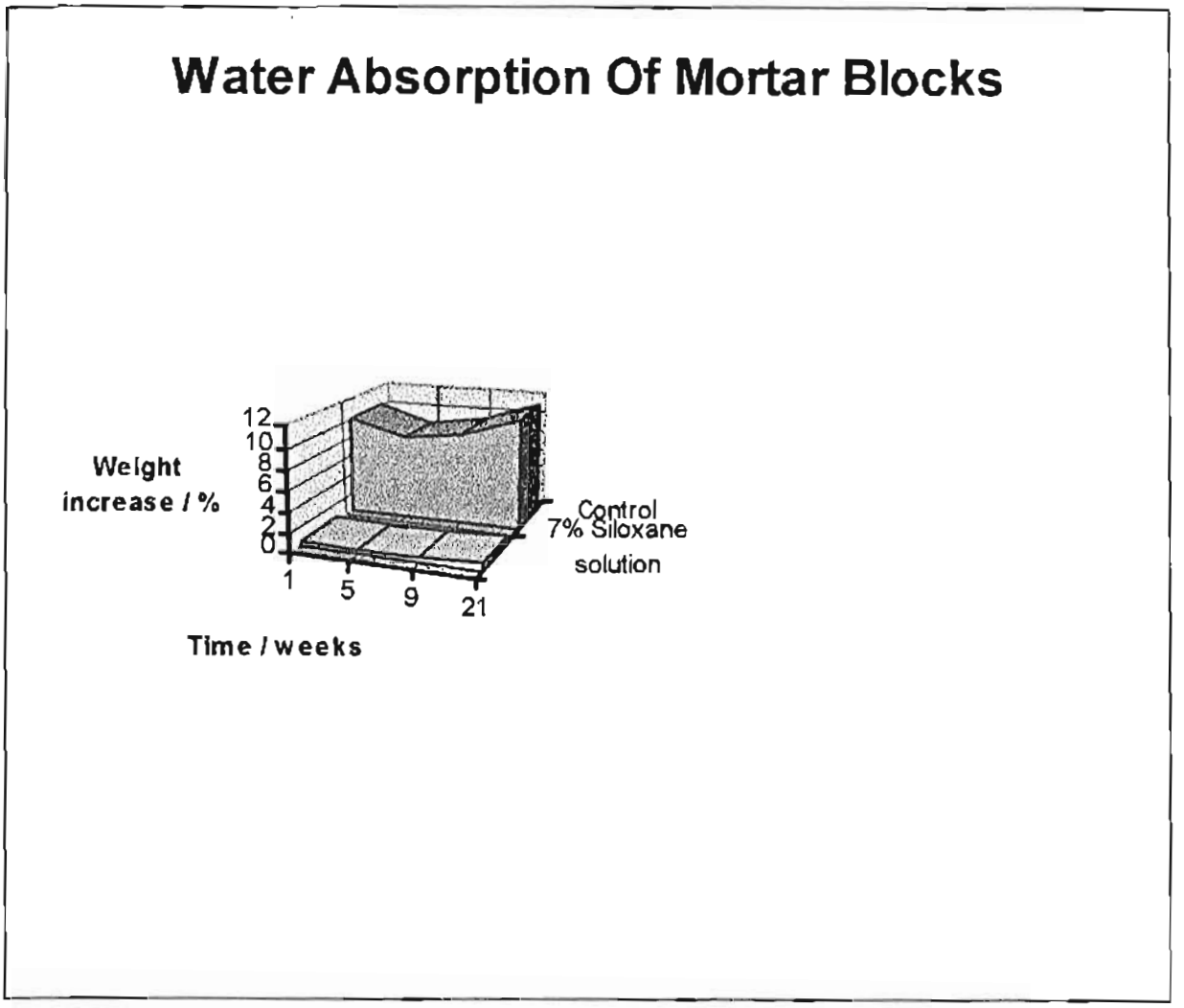
GRAPH 1



c) The third criteria for a chemical DPC is that it also acts on mortar so that a continuous barrier to water is in place.

This was tested by fully treating mortar blocks with the water repellent solution. The blocks were tested with 1 hour gravimentric tests over 21 weeks and 4 weeks between each test. The results for treated and untreated blocks are given in graph 2 . The treated blocks picked up less than 1% water compared to the controls which picked up approximately 10% water for each test over the time period studied. These results indicate that the material acts on mortar giving a good durable water repellent layer that is not washed out when in contact with water. The ability of water to bead on the mortar was also excellent.

GRAPH 2

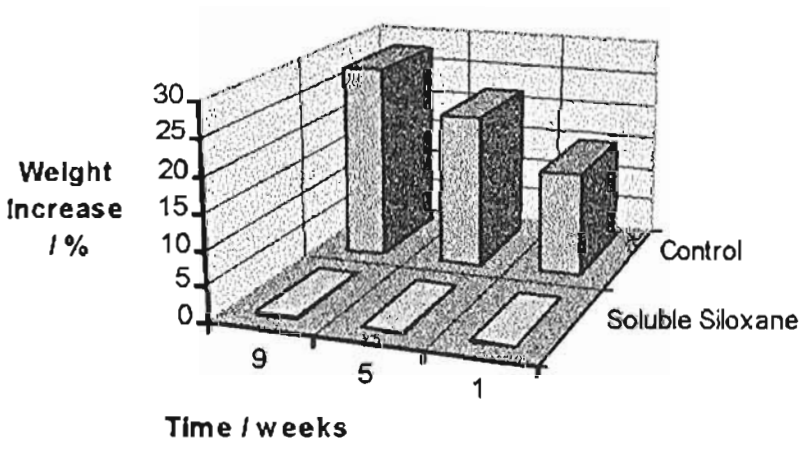


d) Finally the treatment should prevent the uptake of ground water and last the life-time of the building being treated.

To test the ability of the treated bricks to prevent the rise of water up through the walls the Pillar Test used by the British Board of Agrement was adapted and is refered to as the "Brick Wall Test" in this program.
In this test treated bricks were place in water so that the water level was just below the injection holes. Pieces of gauze were placed over the top of the bricks and an untreated brick placed on top as shown in diagram 1. The bricks were left for 7 days. At the end of 7 days the total weight increase for each untreated brick was calculated. This test was repeated 3 times with 4 weeks between each test. Over the 12 week period a neglible amount of water was absorbed. The control, untreated bricks, however, absorbed considerably more water. Tests 2 and 3 absorbed less water than test 1 as the controls had not completely dried out from initial test. Graph 3 shows the accumulative weight gain over the whole testing period.

GRAPH 3

Water Absorbed - Brick Wall Test

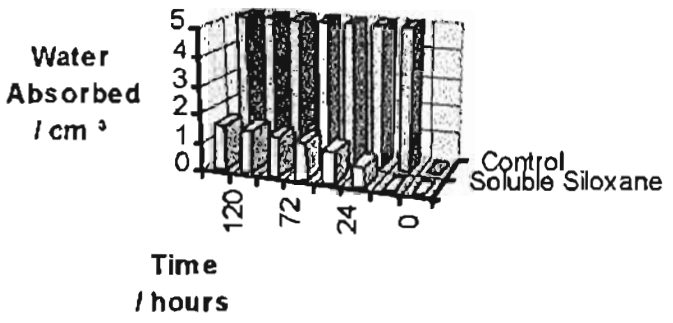


To demonstrate further the water repellent nature of the treated bricks a second test, Hydrostatic Head Test, was run to measure the rate at which water will move through the treated bricks.

Karsten Tubes from Mohren KG (diagrams 2 and 3) were attached to a) the base and b) the side of each brick by interposing a piece of putty between the tube and the substrate. The tubes were filled with water to the zero graduation mark. The quantity of water absorbed by the substrate during a six day period was read off directly from the tube. The test was repeated twice with 4 weeks between each test. The results are given in Graph 4. The bars indicate the water absorbed in the tubes over time. The control bricks absorb all the water within the first hour. The treated bricks began to absorb water after 24 hours. Some of the water decrease may be due to the evapouration from the tubes over the time period monitored.

GRAPH 4

Hydrostatic Head Test On DPC Treated Red Masonry Bricks



5 SUMMARY

1. Water soluble- stable solutions
2. Easy to inject into the bricks
3. Diffuses readily through the bricks
4. Cures to the substrate
5. Works on mortar
6. Good water repellent layer, good durability

6 CONCLUSIONS

This new technology holds significant promise for aqueous siloxane water repellents that can meet the necessary performance and environmental criteria for both an injected DPC material and surface treatment material.

This development offers major benefits in the siloxanes long term solution stability in water thereby making it possible to formulate finished products that remain active for periods of up to 12 months. This fact makes them suitable for distribution.

Where concentrated material is supplied for dilution at point of use the siloxane can be readily diluted to the appropriate concentration and used as required even over extended periods of time.

Additionally, it was shown that the concentration of siloxane solids needed to give the required water repellency was equivalent, if not less than, that required of the siloxane emulsion water repellent technology to achieve the same results.

Further work with this technology is planned and developments are expected.