

PROFESSIONAL SYSTEMS

# SOLUTIONS FOR HUMIDITY AND RISING DAMP ON MASONRY

PRESERVATION AND PROTECTION OF DAMP MASONRY



**san marco**  
SISTEMI VERNICIANTI PER L'EDILIZIA

# Solutions for humidity and rising damp on masonry

## When water is harmful

The problem of humidity in walls is caused by capillary moisture rising from the ground and by the presence of infiltrations. This in turn causes the walls of a building to deteriorate, reducing the thermal isolating properties of the structures and building materials.

This phenomenon may show as poor paint adhesion and when more severe, as loss of plaster. Moisture in walls also contributes to the formation of salt stains on the surface, mould and unpleasant odours inside the home, which have an adverse effect on the environmental microclimatic conditions and on health. It is our job to restore the wall's own healthy characteristics and provide people with suitable and appropriate living conditions.

## Measuring humidity



A hydrometer is used to accurately assess the level of humidity in a wall. This tool allows measuring the percentage of humidity through the conductivity of the wall surfaces.

## Symptoms of humidity

The main symptoms of this problem, which causes a reduction in living comfort, are manifested visually with:

- chalking of the surface
- rising of salts
- mould and algae
- detachment of the finish
- deterioration and disintegration of plaster

High relative humidity in walls brings living discomfort which is usually compensated by increased energy expenditure: additional heating in winter and air conditioning in summer.

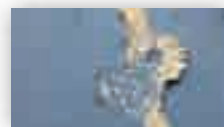
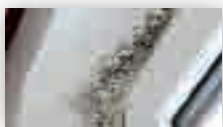
Humidity caused by excessive condensation and penetration of rainwater is a problem that can be defined as "variable" because it is directly influenced by the weather and climate. Instead, the problem of capillary rising damp is more constant over time, and has a greater impact on costs and on the life of the building.



At a certain level, water evaporates but the salts crystallise under the plaster and finish causing the surface to break.



The capillary action forces the water inside the walls.



## The main causes of wall humidity

### EXCESSIVE CONDENSATION

The causes of excessive water condensation on the wall surface are often due to improper thermal insulation (thermal bridges) or excessive moisture in the internal environments caused by poor ventilation or by an inadequate heating system.

### PENETRATION OF METEORIC WATER

The damage caused by the penetration of meteoric water, also identified as descending moisture, comes from the direct contact of the walls with rainwater, which due to design errors or infiltrations, penetrates and stagnates. Water can also permeate through the walls in the form of rainwater infiltrating through the roof and sheathing of the terraces. Meteoric water can melt the salts present in the building materials and create deposits and efflorescence.

### CAPILLARY RISING

The capillary absorption of moisture, also called rising damp, is produced by the direct contact of the lower part of the wall with water or wet ground.

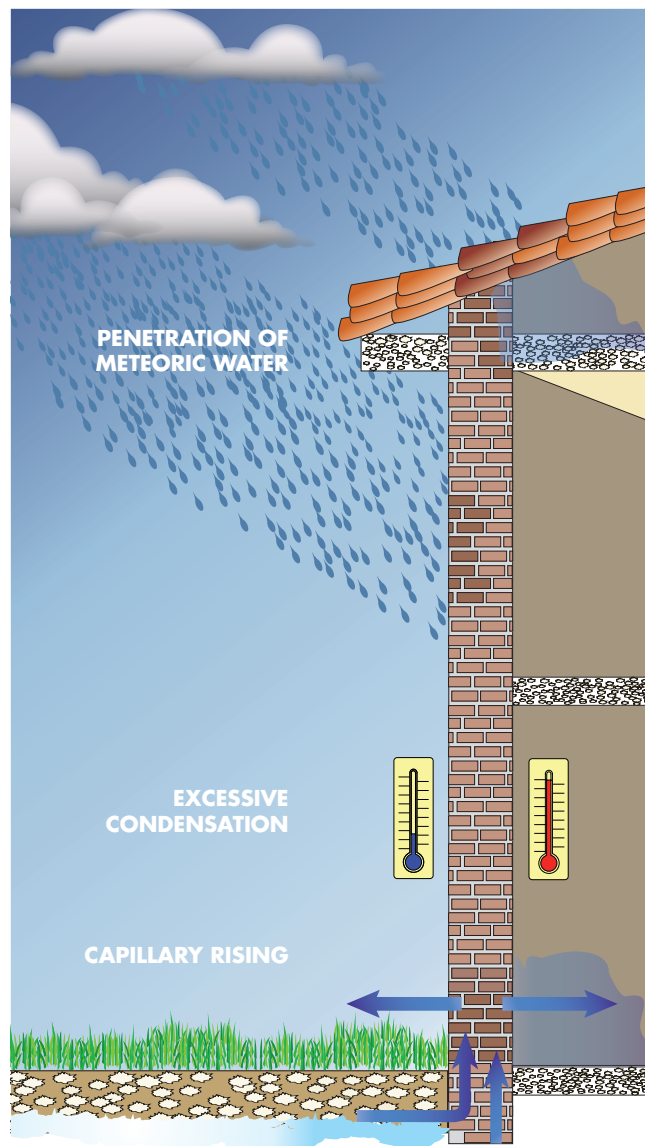
The severity of capillary rising damp also depends on the size of the pores of the materials used.

The phenomenon is more severe in materials that have pores of 1 to 5 m, such as bricks and mortar. In materials with smaller pores, the water rises at a slower rate although it can reach considerable heights.

Finally, the rising height in materials with pores larger than 100 m is negligible since the depression that occurs inside the pore is small. (Depression is the force produced by the capillary action as it draws the water inside).

The capillary force could push the water inside the walls up to heights of ten meters and more. This generally does not occur and the visible humidity level is between 1 and 2 meters because the upward movement of the water is opposed by another force: water evaporation. When environmental conditions are constant, the capillary rise reaches an equilibrium value based on the material's water absorption capabilities and the speed with which it can dispose of the water through evaporation.

Rising damp is the major source of efflorescence in plaster. It is the effect of water "dragging" soluble salts, which from the ground or the inside of the walls migrate towards the outside. In poorly ventilated areas, the salts are deposited in the form of efflorescence. Instead, on well-ventilated surfaces with low relative humidity, the evaporation of water occurs at a faster rate, even before it reaches the outside layers. Therefore, the salts are able to crystallise in the plaster. The continuing phenomenon of crystallisation increases the volume of the salt crystals which expand and cause surface tension. This tension can cause the loss and deterioration of surface finishes or plaster layers.



# Solutions for humidity and rising damp on masonry

## DETERIORATION

Water remaining in the walls can manifest itself through different types of deterioration:

### Physical deterioration

The formation of ice crystals in fresh mortar creates excessive porosity. The ice melts as the temperature increases and the mortar remains porous and fragile.

When subjected to an excessive drop in temperature, the water remaining in old mortar increases in volume and turns to ice. Thermal shocks caused by a series of freeze-thaw cycles give rise to splits and cracks coming from the expansion force of the water as it freezes.

### Deterioration by biological infestation

A damp surface becomes a favourable habitat for the proliferation of organisms such as moss, lichens, algae and mould. These microorganisms could destroy external building materials and reduce indoor living comfort.

### Deterioration of thermal performance

Water is a better thermal conductor than air; stagnating in the walls it increases heat dissipation thus reducing the isolating power of the structure itself. Compared to a dry wall, a damp wall loses 30% to 50% of its insulating capacity.

### Chemical deterioration

Excess water on the walls not only acts as a vehicle for all soluble salts present in mortar, but also collects aggressive chemical agents present in the atmosphere such as sulphur dioxide or carbon dioxide. The solute interacts with the lime binders, lime and calcium carbonate present in the plaster and makes them more soluble. This leads to rapid deterioration in the consistency of the masonry.



# How to intervene

## EXCESSIVE CONDENSATION

The problem of excessive moisture from condensation can be resolved by eliminating the causes i.e. portions of a building where the thermal characteristics are significantly different from the rest of the structure, which increases the heat exchange towards the outside.

Due to the extensive range of diverse building materials (e.g. brick walls and reinforced concrete structures), thermal discontinuity is created in these portions which gives rise to cool zones and thus the formation of condensation.

The greater the temperature difference and the more frequent the cycles of freezing and thawing, the greater the amount of humidity retained in the masonry.

### Solutions

The solution that is increasingly being adopted to treat rising damp is **external wall insulation**.

This treatment not only combats the symptoms of deterioration (mould and algae) but also eliminates the causes that favour its development.

## PENETRATION OF METEORIC WATER

The kinetic energy of heavy rain on the wall generates a washout by the meteoric water that leads to mechanical erosion and moisture absorption depending on the frequency of the events.

Water introduced in this way induces an increase in the porosity of the plaster which in turn leads to alevolarizations, crumbling and detachments.

### Solutions

This problem can only be solved by restoring the sealing of the roofs and recreating a waterproof and continuous barrier.



**MTH**  
marcotherm  
SISTEMA A CAPPOTTO

The **MARCOTHERM EXTERNAL WALL INSULATION SYSTEM** is a range of products that delivers significant energy savings by creating a continuous insulation system around the building. This makes homes more comfortable and healthier, enhances the aesthetic value of each building and increases its preservation properties, protecting it against the deterioration of the building materials. Different insulation products and finishes allow the **MARCOTHERM** system to adapt to any design and requirement. The works performed with the **MARCOTHERM** system can be insured with a 10-year insurance policy.



# How to intervene

## CAPILLARY RISING

Old buildings or even new buildings where the waterproofing is not done properly often have moisture problems. Crumbling of the surface, rising of salts, detachment of the finish and deterioration of the plaster are all symptoms of rising damp.

## Solutions

### PHYSICAL BARRIER

This involves making a horizontal cut in the wall and inserting a sheet of non-porous material to block the rise. Sheets of lead were used in the past, later replaced by plastic materials, while waterproof liners are now used. This technique is difficult to apply because it may damage the stability of the buildings.

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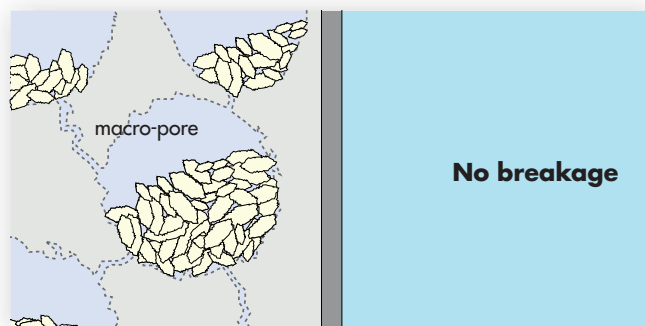
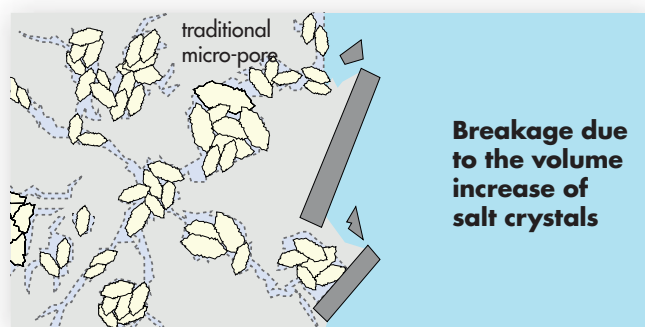
### CHEMICAL BARRIER

This involves injecting special liquids under pressure through a series of holes in the wall. The function of these liquids is to make the pores and capillaries hydrophobic, thus blocking water from rising further. A drawback of this solution is the difficulty of obtaining a homogeneous and continuous impregnation of the wall.

### MACROPOROUS PLASTER

To deal with problems caused by rising damp, a dehumidifying system must be able to expel water through the macroporosity contained in the plaster itself and therefore increase the capacity of water disposal compared to that absorbed from the ground.

The Colorificio San Marco has developed the **NEPTUNUS system**, a range of products designed to maintain the moisture balance in the wall, allowing water to evacuate in the form of vapour.



# Products for the operation

## NEPTUNUS SYSTEM

The **NEPTUNUS** dehumidifying system is ready-mixed cement mortar.

**NEPTUNUS ADDITIVO DI AGGANCIO** - sealant additive for dehumidifying plasters.

**NEPTUNUS ANTISALE** - anti-salt hydrophobizing sealant for dehumidifying systems.

**NEPTUNUS CONSOLIDANTE** - siloxane anti-salt fixative for Neptunus plasters.

**NEPTUNUS INTONACO DEUMIDIFICANTE** restorative plaster for damp walls, CE-mark in accordance with the EN 998-1 standard.

**NEPTUNUS INTONACO DI FINITURA** - dehumidifying leveller for damp walls.

**NEPTUNUS PRIMER H** - siloxane fixative for indoor-outdoor applications.

**NEPTUNUS RIEMPITIVO** - siloxane wall protection with high levelling properties.

**NEPTUNUS** - siloxane preservative for indoor and outdoor use.

## BIOMARC DEHUMIDIFYING SYSTEM

The walls of green buildings or historical buildings affected by moisture and efflorescence can be restored with plaster made of pure and natural hydraulic lime from the **BIOMARC DEUMIDIFICANTE** line.

The pure and natural hydraulic lime (NHL 3.5) used in the BIOMARC line carries the CE-mark in accordance with the EN 459-1 standard and meets the requirements of environmental compatibility.

**BIOMARC RINZAFFO DEUMIDIFICANTE** - natural lime based anti-salt grabbing hold primer made of natural lime, CE-mark in accordance with the EN 998-1 standard.

**BIOMARC INTONACO DEUMIDIFICANTE** - ecological restoration plaster made of natural lime, CE-mark in accordance with the EN 998-1 standard.

**BIOMARC FINITURA DEUMIDIFICANTE** - ecological restoration plaster made of natural lime.

The **BIOMARC DEUMIDIFICANTE** line of products can replace the Neptunus cement products within the anti-humidity cycle.

For information on the times and preparation methods and on how to avoid errors that may undermine the effectiveness of the intervention refer to each product's technical specifications.



# Products for the operation

## FINISHES

To guarantee the effectiveness of the dehumidifying system, both cement and lime based, choose a finish with a high level of breathability, as shown in TAB. 1

### Plaster NEPTUNUS

**NEPTUNUS**  
ANTISALE

**NEPTUNUS**  
ADDITIVO DI  
AGGANCIO

**NEPTUNUS**  
INTONACO  
DEUMIDIFICANTE

**NEPTUNUS**  
INTONACO  
DI FINITURA

**NEPTUNUS**  
CONSOLIDANTE

**NEPTUNUS**  
PRIMER H

### Finishes

### Plasters BIOMARC DEUMIDIFICANTE

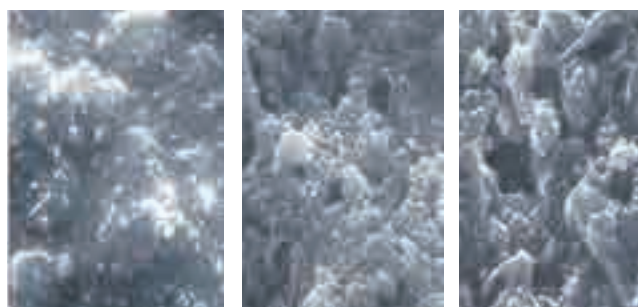
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	Lime	Silicates	Siloxanes
outdoor/indoor	<b>ANTICA CALCE</b>	<b>MARCOSIL PITTURA LISCIA</b>	<b>NEPTUNUS RIEMPITIVO</b>
	<b>MARMO ANTICO</b>	<b>MARCOSIL PITTURA RIEMPITIVA</b>	<b>NEPTUNUS</b>
	<b>MARMORINO CLASSICO</b>	<b>MARCOSIL KP</b>	<b>VELATURE</b>
	<b>INTONACHINO MINERALE</b>		
indoor	Lime	Silicates	Siloxanes
	<b>ANTICA CALCE PLUS</b>	<b>MARCOSIL DOMUS</b>	<b>PERLACEO</b>
	<b>GRASSELLO DI CALCE</b>		

**BIOMARC**  
RINZAFFO  
DEUMIDIFICANTE

**BIOMARC**  
INTONACO  
DEUMIDIFICANTE

**BIOMARC**  
FINITURA  
DEUMIDIFICANTE



Lime

Silicates

Siloxanes

Comparison of the porosity of the paint film.





## SILOXANES

The siloxane products from the NEPTUNUS line offer good breathability and water resistance. In fact, the siloxane binders derive from metallic silicon, extracted in turn from quartz sand. This technological evolution positioned between tradition and modernity solves the ever-increasing problems associated with environmental aggression.

The siloxane products also offer high penetration, entering deeply into the support to effectively protect surfaces from the deteriorating effects of weathering (freezing/thawing) and external aggressive chemicals (acid rain), and give the applied product low dirt adherence as it prevents dirt and smog from settling. Rain helps keep the surfaces clean by washing them periodically. In fact, it is able to change the contact angle between the water and the finish, so that rainwater slides along the wall without being absorbed.

Finally yet importantly, the water repellence/breathability effect hinders the formation of a damp environment, favourable to proliferation of mould and moss, which in turn keeps the surfaces intact. Without compromising the breathability of the system, the VELATURE and PERLACEO (indoor) decorative products can be applied on the NEPTUNUS and NEPTUNUS RIEMPITIVO finishes, which are also siloxane based.

The NEPTUNUS siloxane finishes belong to the GREENSPIRIT line, a selection of high-tech natural products for bio-construction with low environmental impact.

## SILICATES

Highly breathable and weather-resistant coatings, the silicates from the MARCOSIL line are mineral products ideal for the restoration of historical/artistic buildings.

The high adhesion properties of MARCOSIL coatings come from a chemical reaction between the potassium silicate and the mineral components making up the wall support. This reaction, known as "silicatization," leads to the formation of a very strong insoluble compound, permeable to air and water vapour, which effectively protects the surfaces from deterioration caused by atmospheric agents, pollutants and UV rays. It is also mould-resistant.

MARCOSIL DOMUS, MARCOSIL PITTURA LISCIA and MARCOSIL RIEMPITIVO comply with the requirements of the DIN 18363 standard, which provides for a maximum organic binder content of 5%.

The MARCOSIL KP 1.2 and MARCOSIL KP 1.5 plasters not only have the typical characteristics of mineral products, but are also hydrophobized and mould/algae resistant.

The MARCOSIL silicate system belongs to the GREENSPIRIT line of products with low environmental impact.

## LIME

Lime is one of the oldest finishing materials, appreciated for its ability to bind directly to the wall support and its compatibility with most manmade architectural works.

Lime-based mineral finishes are particularly suitable for protecting and decorating interiors and the facades of buildings, recreating old-fashioned atmospheres that embellish and make the architectural work unique and special.

The highly decorative lime coatings come in soft, enveloping and shaded colours. Their high breathability ensures a constant exchange of vapour, keeping the humidity level of your home in perfect balance, while their effective disinfecting and preserving action prevents the formation of mould. These advantages guarantee perfect living comfort and enhance the emotional experience of your home.

The lime-based finishes belong to the GREENSPIRIT line with low environmental impact.

Marmorino Classico, Antica Calce and Intonachino Minerale GF have obtained the EPD pre-certification EPD (Environmental Product Declaration).

# Dehumidifying system

## CAPILLARY RISING

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To deal with problems caused by rising damp, a dehumidifying system must be able to expel water through the macro-porosity contained in the plaster itself and therefore increase the capacity of water disposal compared to that absorbed from the ground.

The Colorificio San Marco has developed the NEPTUNUS system, a range of products designed to maintain the moisture balance in the wall, allowing water to evacuate in the form of vapour.

## 1. Level of rising damp

Identify the level of rising damp and pinpoint the limit of the intervention at 50 cm above the highest point where the humidity is present.

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FIRST



## 2. Demolish and clean

Demolish the plaster until the walls are bare.

To remove excess salts, wash the masonry with pressurised water or if this is not possible clean with a brushing machine.



## 3. Anti-salt treatment

With a brush, apply a layer of NEPTUNUS ANTISALE to create a hydrophobic zone that does not allow the migration of capillary water and consequently the emission of salts and efflorescence.

Because of its chemical nature, it does not alter the permeability of the support.



# Dehumidifying system

## 4. Rough coat

After 24 hours, mix the NEPTUNUS INTONACO DEUMIDIFICANTE with the NEPTUNUS ADDITIVO DI AGGANCIO for one minute: 5 litres of additive per 25 kg of mortar and 1 litre of water.

Apply a spray of NEPTUNUS INTONACO DEUMIDIFICANTE on the surface without covering it completely (cover a max. of 60%).



## 5. Arriccio (first layer of plaster)

At least 1 hour after application of the sealant, apply NEPTUNUS INTONACO DEUMIDIFICANTE mixed with 20% of water. The mixing times of the products can vary depending on the type of mixer and the temperature conditions: low temperatures require less time.

Normally, with a normal mixer (pear-shaped) about 8/10 min, with a planetary mixer (with vertical axis mixer) or with electric mixer about 4/6 min.

The resulting mixture must be light and cellular.

If it remains at rest for more than 15 min, mix again before use. If necessary, add more water.



## 6. Checking of the thicknesses

To ensure long-lasting effectiveness and durability of the NEPTUNUS INTONACO DEUMIDIFICANTE macro-porous system, it is recommended to apply a minimum thickness of 2 cm. Before applying NEPTUNUS INTONACO DEUMIDIFICANTE, and to create a flat surface with the proper thickness, prepared the construction using special "guides" at a known thickness and screed bubble level. Any excess plaster must be removed while still fresh using a straight edge bar. Avoid heavy troweling.



## 7. Thin layer

After 24 hours, mix NEPTUNUS INTONACO DI FINITURA with 22% of water (5.1/5.4 litres of water per 25 kg of mortar).

Moisten the support with water, apply NEPTUNUS INTONACO DI FINITURA with a steel spatula, and smooth with a sponge trowel so as not to harm the macro-porosity of the system.



# Dehumidifying system

## 8. Primer

Once matured on the support (after about 20/28 days), it is recommended to measure the level of humidity remaining in the system.

With the wall dry, apply a layer of NEPTUNUS CONSOLIDANTE (diluted at 15-20% with a synthetic diluent) on NEPTUNUS INTONACO DI FINITURA.

For fixation of the surfaces made of traditional plaster, use NEPTUNUS PRIMER H for indoor-outdoor use, diluted at a ratio of 1:2 with water.

## 9. Finish

To get the best performances of the dehumidifying system, use finishing products that have high breathability and low water absorption.

### A) Smooth finish

On a dry wall, apply the products from the NEPTUNUS, MARCOSIL line and lime-based products.

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## B) Thick finish

On a dry wall, it is possible to apply a thick highly breathable coating such as MARCOSIL KP 1.5 or MARCOSIL KP 1.2 or lime-based coatings.



## BREATHABILITY ACCORDING TO THE KUNZEL THEORY

To effectively treat capillary rise, dehumidifying plasters must not only prevent salt from rising on the plaster surface but must also have low water absorption and high vapour breathability.

The reference technical parameter for comparison is the **resistance to the passage of water vapour** which is expressed as  $S_d$ ; i.e. the resistance to vapour diffusion in relation to the air layer thickness.

To establish whether a protective coating is technically suitable for a building, refer to the **DIN 18550 standard** which is based on the Kunzel Theory and states that **an external coating applied on absorbing surfaces must meet the following three conditions:**

$$S_d = \mu \cdot S \leq 2 \text{ m}$$

$S_d$  = resistance to vapour diffusion (equivalent air layer) unit of measurement: in  $\text{kg/m}^2 \text{ h } 0.5$

This expresses the thickness of a static layer of air in meters which has the same resistance to water vapour diffusion as the layer thickness "s" of a building material. The  $S_d$  of a wall is the sum of the  $S_d$  of its components.

$\mu$  = resistance factor to vapour diffusion.

This expresses the relationship between the resistance to vapour diffusion offered by a given material and the resistance offered by air in the same conditions. Being a ratio, it has an absolute value.

$S$  = thickness of the coating (in meters).

$$W \leq 0.5 \text{ kg/m}^2 \text{ h } 0.5$$

$W$  = water absorption coefficient.

This represents the resistance to water penetration according to the DIN 52617 standard where h is the time expressed in hours.

$$S_d \times W \leq 0.2 \text{ kg/m}^2 \text{ h } 0.5$$

When the water permeability of a layer is close to its maximum value, its resistance to the passage of vapour must be close to the minimum.

In practice, Kunzel expressed in mathematical terms the fundamental concept that water must not penetrate a wall, and if it does penetrate, must be able to escape. This concept is certainly supported by both good sense and experience.

# Insurance policy

## GUARANTEE OF QUALITY AND SAFETY FOR YOUR HOME

Since 1999, the Colorificio San Marco in collaboration with INA Assitalia has been offering customers the opportunity to **protect their work with a 5-year insurance policy** for the San Marco products.

The **“Grandi Lavori” policy** (infrastructural works) is dedicated to all painting works and guarantees more complex interventions for a period of five years.

Type of policy	Warranty coverage (years)	Costs
Infrastructural Works	5	€ 150.00 + 0.70% of the total cost of the work (up to € 50,000.00)
		€ 150.00 + 0.50% of the total cost of the work (over € 50,000.00)

\* This possibility is reserved for installers who have obtained the ICMQ accreditation.



COMPANY WITH  
QUALITY SYSTEM  
CERTIFIED BY DNV  
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**san marco**  
SISTEMI VERNICIANTI PER L'EDILIZIA

Colorificio San Marco SpA  
Via Alta 10 - 30020 Marcon (VE) - Italy  
Tel +39 041 4569322  
Fax +39 041 5950153  
[www.san-marco.it](http://www.san-marco.it)  
[info@san-marco.it](mailto:info@san-marco.it)  
[export@san-marco.it](mailto:export@san-marco.it)