StoCretec

Building with conscience.

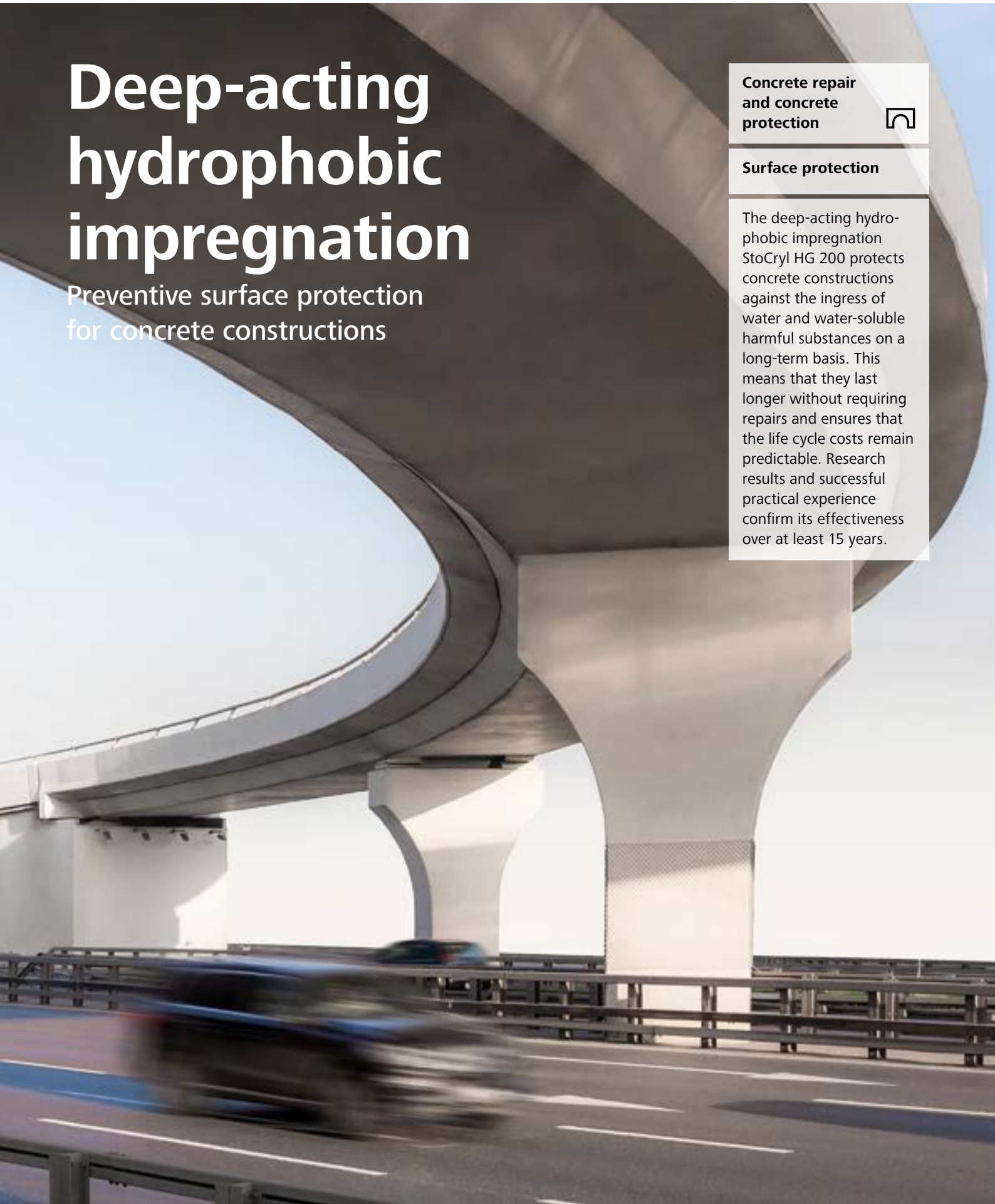
Deep-acting hydrophobic impregnation

Preventive surface protection for concrete constructions

Concrete repair and concrete protection

Surface protection

The deep-acting hydrophobic impregnation StoCryl HG 200 protects concrete constructions against the ingress of water and water-soluble harmful substances on a long-term basis. This means that they last longer without requiring repairs and ensures that the life cycle costs remain predictable. Research results and successful practical experience confirm its effectiveness over at least 15 years.



Cover photo:
Photo: Yury Gubin/Adobe Stock

Contents

Long-term protection for concrete constructions

Prevention means they last longer without requiring repairs

Building with concrete has proven its worth around the world over many years. It is a cost-effective way of creating an infrastructure that serves the people who use it and that enables a competitive economy. We must preserve this infrastructure in a way which conserves resources as effectively as possible.

Unavoidable influences including aggressive pollutants such as chlorides, weather conditions, and temperature fluctuations lead to:

- Damage to the building fabric, potentially resulting in the construction losing its load-bearing capacity
- Short maintenance and repair intervalls
- A significant increase in the life cycle costs due to unplanned repair work

Deep-acting hydrophobic impregnation provides long-term protection for concrete constructions by preventing the capillary absorption of aggressive, water-based salt solutions into the concrete surface zone. Application of the deep-acting hydrophobic impregnation is fast and easy. This preventive measure is used for both new and existing constructions: in the case of existing structures, it protects them from sustaining further damage; in the case of new constructions, it is a way of ensuring from the outset that they last longer without requiring repairs. In this way, deep-acting hydrophobic impregnation prevents additional unplanned maintenance costs.

Both research results and successful practical experience over the last 15 years attest to the fact that applying deep-acting hydrophobic impregnation to cementitious building elements is an effective and sustainable way of protecting against the ingress of aggressive substances.

Alongside traffic structures, deep-acting hydrophobic impregnation can also be used to protect buildings, parking structures, as well as industrial and commercial structures.
Photo: Isabell Munck

Bridge pier shows damage caused by chloride-induced reinforcement corrosion.
Photo: Wacker Chemie AG

Chloride-induced reinforcement corrosion

De-icing salt dissolved in water is transported into the concrete surface zone via capillary absorption. If the chlorides reach the steel reinforcement, electrochemical processes take place, resulting in localised steel dissolution or “pitting corrosion”. This type of damage is often not visible to the naked eye, but it means that the stability of the construction is already at risk. It is therefore particularly critical in the case of infrastructure constructions. As well as resulting in high costs, repairing corrosion damage also leads to significant environmental pollution and economic deficits.

StoCryl HG 200 hydrophobic gel

High depth of penetration ensures maximum effectiveness

The StoCryl HG 200 hydrophobic gel forms a protection layer with a thickness of several millimetres under the concrete surface, protecting the concrete against the ingress of water and water-soluble harmful substances. Unlike conventional hydrophobic impregnation, it completely blocks the capillary absorption capacity of the porous concrete surface zone. This is made possible by the high depth of penetration of the active ingredient (around six millimetres). The concrete surface zone remains water vapour permeable.

StoCryl HG 200 is based on long-chain silanes and the carrier material bentonite. This non-Newtonian fluid makes it possible to apply large amounts of material in one application cycle. Therefore, a large amount of the active ingredient is deposited onto the building element surface. The interfacial tension between the silane and the water-logged pore wall actively transports the active ingredient into the concrete surface zone. The surface tension of the long-chain silanes changes very slowly, therefore enabling the active ingredient to penetrate the concrete surface zone over a long time and with a high depth of penetration.

As the gel penetrates into the concrete surface zone, the silanes react with the water that condenses on the pore walls. In a further reaction step, the silanols that are formed cross-link with one another and with the hardened cement paste to form polysiloxanes. This results in a hydrophobic, chemically inseparable layer bonded to the cement, which prevents capillary absorption.

Properties

- Surface protection under the concrete surface
- Very high depth of penetration of the active ingredient
- Very high, long-lasting effectiveness
- No film formation
- Concrete character is retained
- No bubbles
- No scaling
- No fading
- No weathering

StoCryl HG 200 allows the active ingredient to penetrate the concrete surface zone over a long time due to its surface tension.

StoCryl HG 200 is sprayed onto a bridge pier.

Field test confirms effectiveness

A field test carried out within the area of responsibility of the motorway authority for South Bavaria (Autobahndirektion Bayern Süd) has confirmed that the StoCryl HG 200 deep-acting hydrophobic impregnation provides highly effective, long-lasting concrete protection. For the purposes of the test, the deep-acting hydrophobic impregnation was applied to particularly exposed elements of eight existing bridges. The following aspects were studied over a period of 15 years:

- Active ingredient profile of the deep-acting hydrophobic impregnation
- Chloride penetration
- Carbonation speed

Results: The depth of chloride penetration was virtually unchanged. The carbonation speed slowed down. Water absorption continues to be prevented.

Conclusion: The deep-acting hydrophobic impregnation remains just as effective after 15 years and is preventing chloride from being absorbed into the concrete. The chloride front does not reach the reinforcing steel. In addition, the deep-acting hydrophobic impregnation slows down the carbonation speed. A sufficiently high depth of penetration is required in order to ensure effectiveness.

The field test proves that deep-acting hydrophobic impregnation is a sustainable way of making concrete constructions last longer without requiring repairs. Extensive studies on Swedish constructions indicate that deep-acting hydrophobic impregnation has a working life of up to 25 years.

How to extend the lifetime right from the planning stage

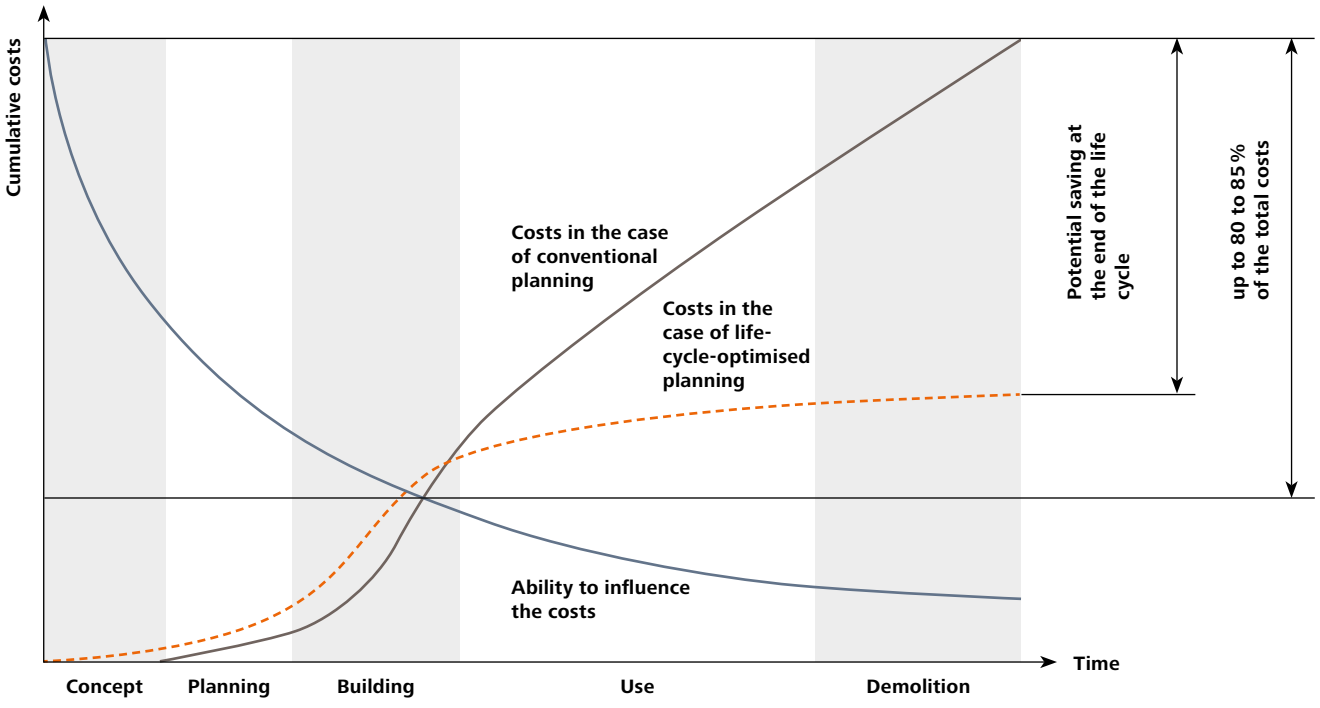
Measures that will have a positive influence on the working life of concrete constructions

Take action today for the benefit of tomorrow. Simple measures can increase the working life not only of new structures, but also of existing constructions. This reduces the costs of a concrete construction significantly over the course of its life cycle – for a more sustainable approach.

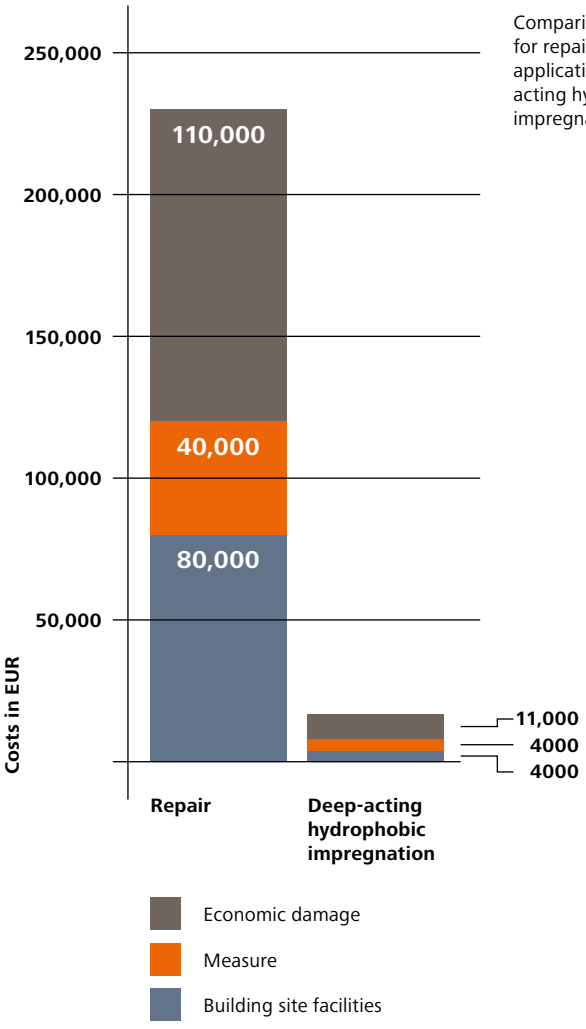
In its "Guidelines for Sustainable Building", the German Federal Ministry of the Interior, Building and Community defines the life cycle costs as an economic protection objective. It points out that the preservation costs need to be taken into account right from the planning stage – once the construction has been built, it is very difficult to influence these costs in any way. A new construction with limited function or a lack of durability will result in considerable preservation expenses. In many cases, repair work can only be carried out during operation with significant financial implications. Examples from the field indicate that repair costs can be up to three times higher than the costs to demolish the existing structure and build a replacement. This can be avoided by means of preventive technical measures. Furthermore, they can preserve the current condition of existing constructions and prevent the damage from progressing. On average, the preventive measures cost a tenth of what a repair would cost.

Image on right:
A96 noise reduction structure, BW 159-1, Germering Süd, DE
StoCretec expertise:
StoCryl HG 200

Diagram below:
Life cycle costs
Source: Guidelines for Sustainable Building, 2019



Cost comparison:
The costs for repair work and those for the application of a deep-acting hydrophobic impregnation were compared on the basis of data from the motorway authority for South Bavaria. The motorway authority estimated costs of EUR 230,000 to repair a bridge, compared to an estimated total of EUR 19,000 to apply a deep-acting hydrophobic impregnation to the same construction. However, various studies indicate an even greater difference than the EUR 211,000 calculated here. In 80 per cent of the repaired constructions, new instances of damage were observed after just eight to ten years. By contrast, the effectiveness of deep-acting hydrophobic impregnation is scientifically proven over a 20-year period. Applying effective deep-acting hydrophobic impregnation to constructions once they have been completed means that they last much longer without requiring repairs and ensures that the life cycle costs remain predictable.



Comparison of costs for repair work and for application of deep-acting hydrophobic impregnation

Ensuring long-term functionality

Achieving success through proper planning and execution

The following measures are required in order to ensure the long-term effectiveness of a deep-acting hydrophobic impregnation.

Planning
Drill cores are taken from the element of an existing construction that requires protection. These cores are to be tested for carbonation depth, carbonation progress, porosity, and chloride content. The carbonation progress and resulting corrosion risk make it possible to estimate the remaining working life of the construction. The capillary porosity of the reinforced concrete also influences the durability of a construction and, at the same time, plays a key role in the application of a deep-acting hydrophobic impregnation. It is determined by means of immersion weighing using drill core samples. The amount of water that is absorbed serves as a reference for the effective depth of penetration and, hence, the effectiveness of the hydrophobic impregnation. The depth of chloride penetration provides information about the durability of the concrete. If the chloride front reaches the reinforcing steel, a subsequent surface protection measure will no longer be effective. Furthermore, in the case of new constructions, it is important to ensure that the concrete surface zone is sufficiently dry. Capillary pores that are filled with water will block the transport of the active ingredient. Sample surface areas may be required.

Implementation
The effective depth of penetration and the minimum active ingredient content can be determined on the basis of the preliminary investigations. These details can be stipulated as specifications in the tender and are used for quality control purposes during application. A construction diary is used to document information such as the weather conditions during application and the daily output rates.

The highly viscous StoCryl HG 200 hydrophobic gel offers an advantage when it comes to monitoring on site: it remains on the surface for a while after application. The applied quantity can be checked using a wet film layer thickness gauge.

Quality control
Following application of the deep-acting hydrophobic impregnation, quality control is carried out in three steps:
1) Check the application of the hydrophobic impregnation
2) Take drill cores from the surface to which the hydrophobic impregnation has been applied
3) Check the effective depth of penetration and the minimum active ingredient content of the hydrophobic impregnation using FT IR spectroscopy

Image below:
Taking a drill core sample
Photo: Wacker Chemie AG

Image on right:
Measuring the layer thickness of StoCryl HG 200 during application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