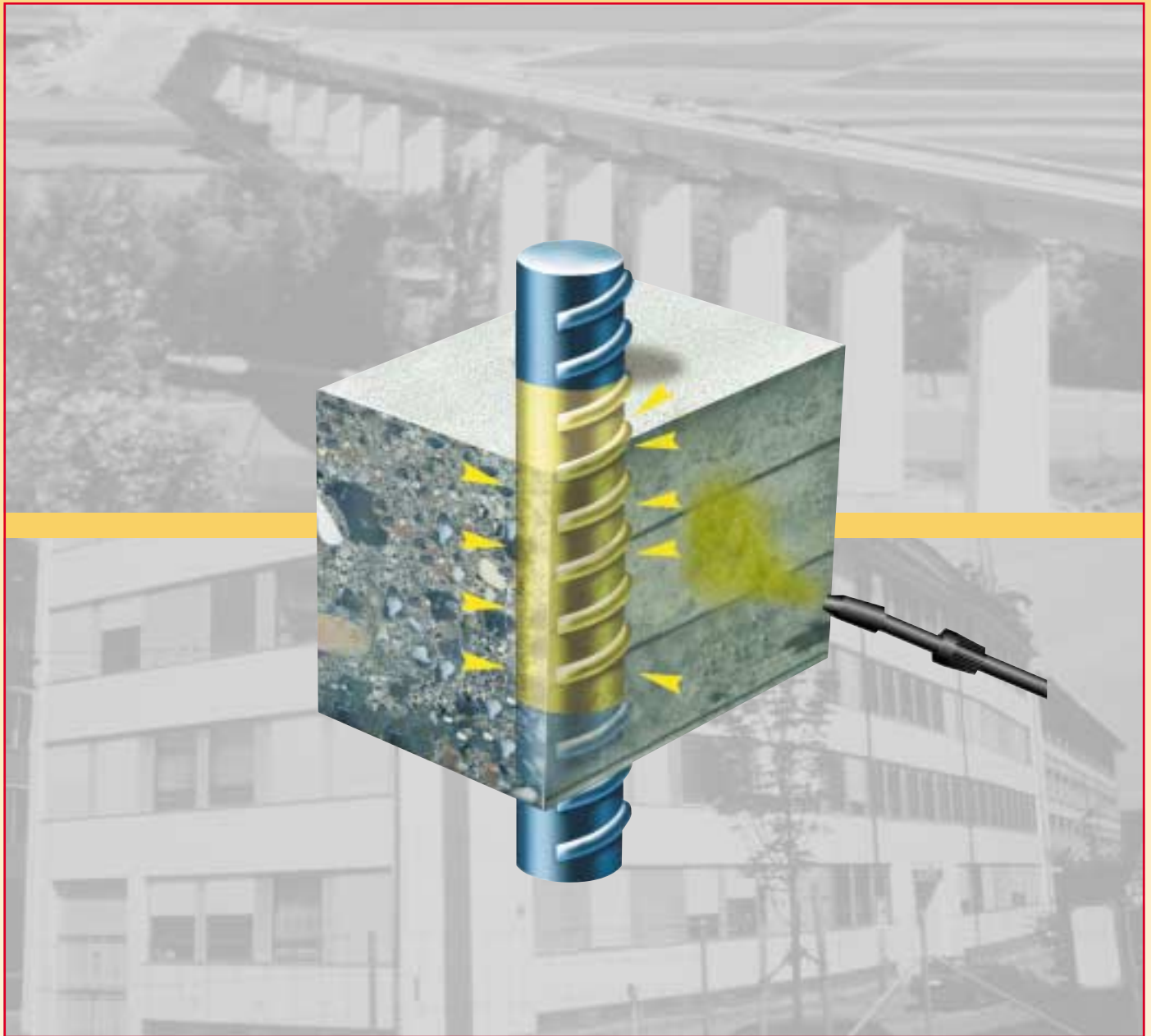


# Sika® FerroGard®-903

The unique multi-functional surface applied corrosion inhibitor for reinforced concrete



- ▲ Delays the onset of corrosion
- ▲ Reduces the rate of corrosion
- ▲ Extends service life
- ▲ Reduces noise and dust
- ▲ Reduces repair times

# Corrosion in reinforced concrete

For more information on Sika visit [www.barbourproductsearch.info](http://www.barbourproductsearch.info)

## Aggressive influences on reinforced concrete

In reinforced concrete the steel is normally protected against corrosion by the passivating alkalinity of the cement matrix. Due to the ingress of aggressive environmental influences the steel can corrode.

Three conditions must exist for reinforcing steel to corrode:

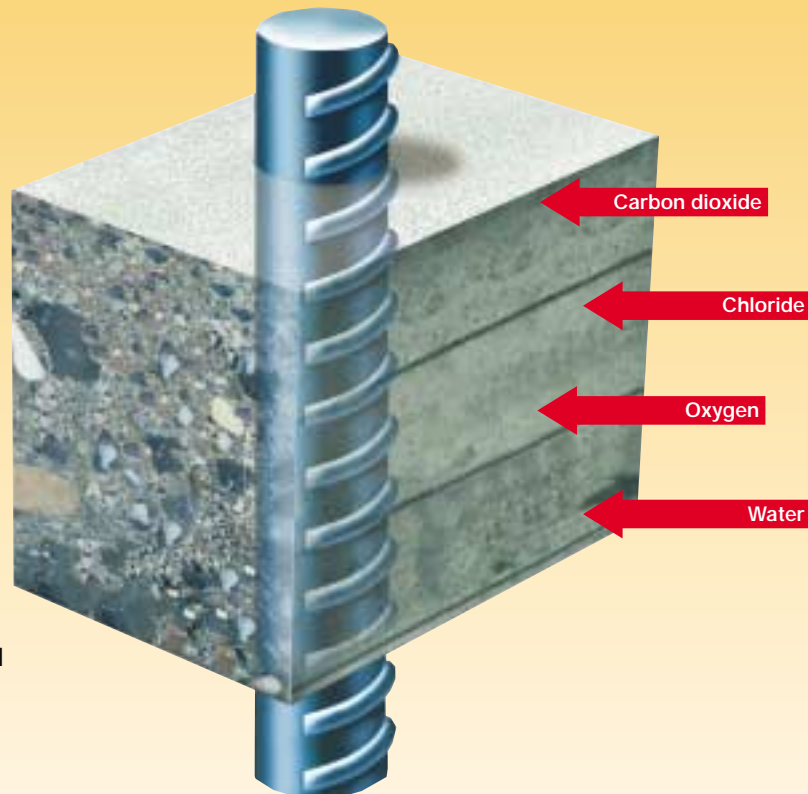
- ▲ The passivation of the steel must have been destroyed by chlorides or by carbonation
- ▲ The presence of moisture as an electrolyte
- ▲ The presence of oxygen

### Carbonation

Carbon dioxide ingress causes carbonation of the cement matrix progressively reducing the passivating alkaline protection of the steel reinforcement to a level where corrosion can occur.

### Chloride attack

Chloride ions from deicing salts or marine exposure are carried into the concrete in solution in water. At the steel surface, even in alkaline concrete, they attack and break down the passivating layer and then accelerate the steel corrosion process.



## Corrosion Management with Sika®

### Application of Sika® FerroGard®-903

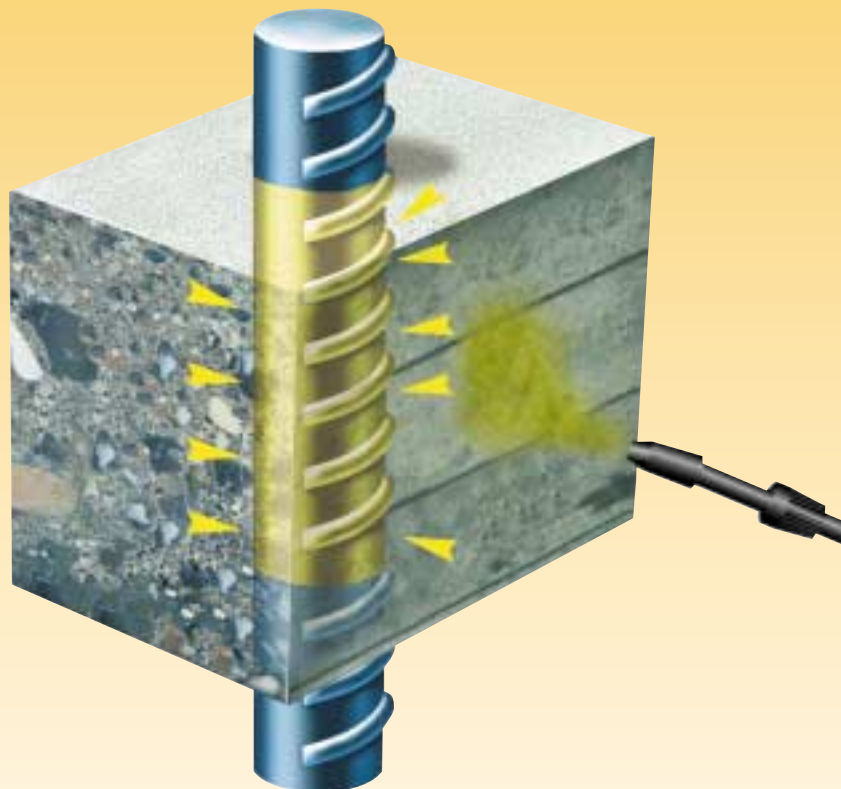
Sika® FerroGard®-903 is applied as an impregnation by spray, roller or brush onto the surface of the concrete. The corrosion inhibitor penetrates into the concrete and protects the reinforcement by forming a protective film on the steel surface. Through this the onset of corrosion is delayed and the rate of corrosion reduced.

Sika® FerroGard®-903 is a clear colourless liquid which does not itself normally alter the aspect of fair-faced concrete.  
(Check if used in conjunction with chemical cleaners)

Sika® FerroGard®-903 can penetrate over 80mm, depending on concrete permeability.

Sika® FerroGard®-903 reaches the surface of the steel through different transport mechanisms:

- ▲ During application of Sika® FerroGard®-903 transportation is mainly by capillary suction – like water
- ▲ Sika® FerroGard®-903 is later carried in solution by the penetration of water – like chlorides
- ▲ Sika® FerroGard®-903 also travels by gas diffusion – like carbon dioxide



## The effect of these aggressive influences

### Chlorides/Carbonation

As soon as sufficient chloride ions (from deicing salts or marine exposure) or the carbonation front have reached the steel surface, the passive layer is destroyed and corrosion accelerates.

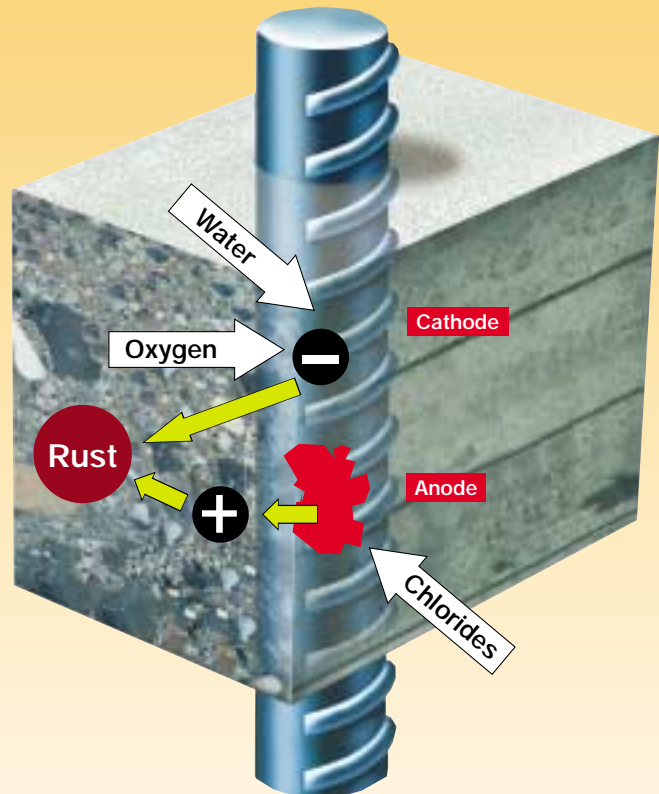
### Contact with water (moisture)

The original neutral iron will receive a negative charge as the positively loaded iron ions have the tendency to dissolve. The water film around the metal turns positive.

### Contact with oxygen

The oxygen takes on the negative charge of the iron ions which have gone into solution. The result is iron hydroxide, the first stage of rust.

Conditions for corrosion and damage exist



# FerroGard<sup>®</sup>

# Technology

## The performance of Sika<sup>®</sup> FerroGard<sup>®</sup>-903

### Protective layer

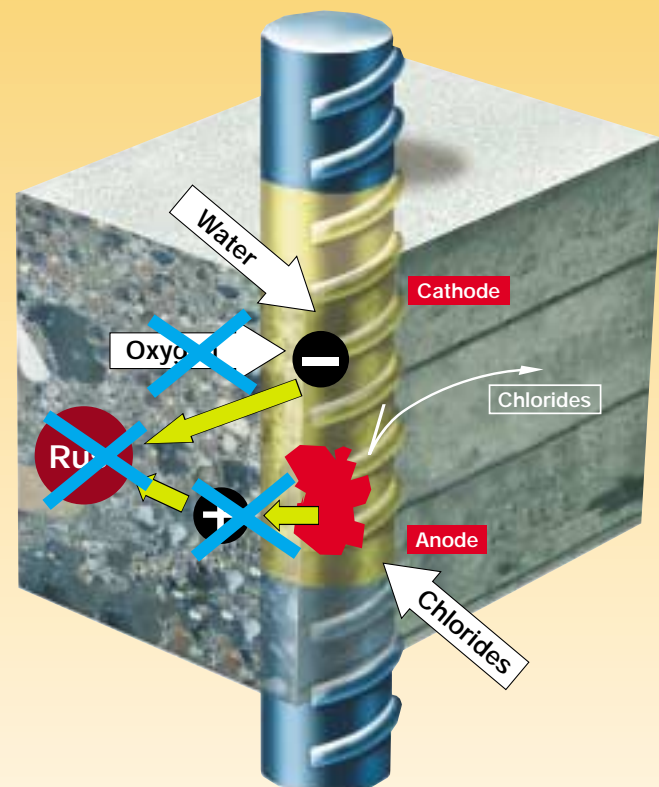
Sika<sup>®</sup> FerroGard<sup>®</sup>-903 forms an adsorbed protective film on the reinforcement.

The process of forming this protective film takes place even in carbonated concrete and even with the presence of chlorides in the concrete.

### Delay of the corrosion process

- ▲ The dissolution of the iron in contact with water will be reduced thanks to this passivating protective film
- ▲ This film is also a barrier to the reduction of oxygen which will be prevented

Conditions for corrosion are greatly reduced by this dual action effect of Sika<sup>®</sup> FerroGard<sup>®</sup>-903





# Existing Conditions and Aggressive Influences on the Structure

# Objectives and Requirements

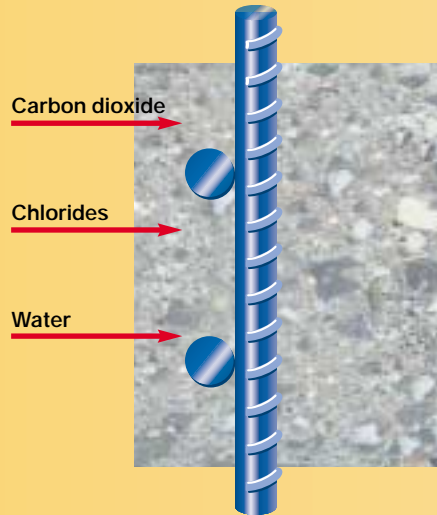
# Reinforcing

## New construction.

New building/new concrete e.g. high quality architectural concrete without protective coating.

The steel reinforcement is protected by the passivating alkalinity of the cement matrix, pH 12.5 to 13.5.

With the ingress of aggressive environmental influences, steel reinforcement can corrode. The concrete will be carbonated or passivation broken down by penetrating chlorides.



- ▲ Increasing service life of structure
- ▲ Preservation of architectural aspects
- ▲ Preserving protection to reinforcement
- ▲ No protective coatings

Princ  
to EN

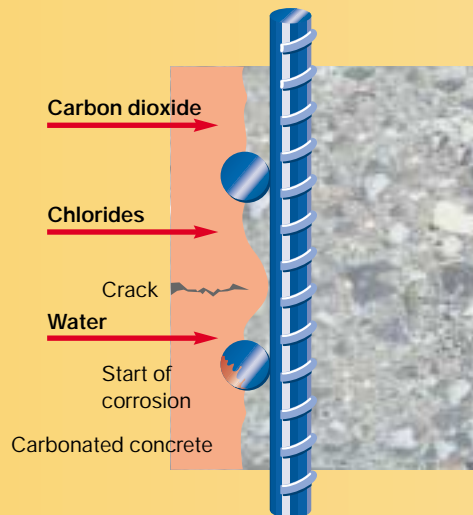
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## Well advanced corrosion risk but no visible corrosion damage

Concrete facade or civil engineering structure without protective coating.

- ▲ Steel reinforcement in a carbonated environment
- ▲ Perhaps light corrosion already exists
- ▲ No visible corrosion damage



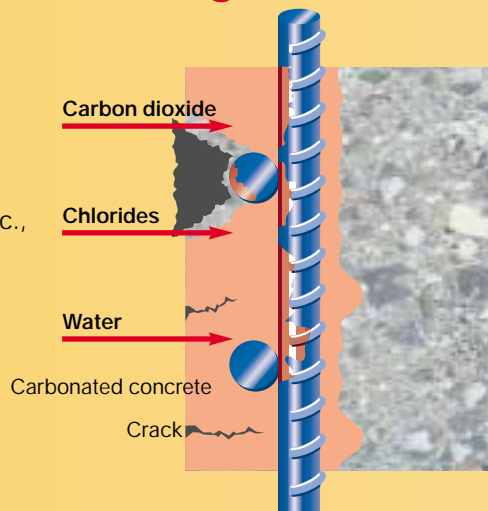
- ▲ Preventative maintenance
- ▲ Protection against possible concrete damage
- ▲ Re-passivation of steel
- ▲ Long term protection against further environmental influences (carbonation, deicing salt, etc.)

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## Visible corrosion damage. Concrete repair necessary.

Concrete surface (facade or civil engineering structure) without coating but with visible corrosion damage.

e.g. spalling concrete, cracks, etc., concrete repair is necessary.



- ▲ Active maintenance
- ▲ Repair of damaged concrete surfaces only
- ▲ Structurally sound carbonated / chloride contaminated concrete remains
- ▲ Controlled concrete breakout
- ▲ Re-passivation of steel
- ▲ Protection against the development of latent damage
- ▲ Prevent the possibility of incipient anode corrosion
- ▲ Long term protection against further environmental influences

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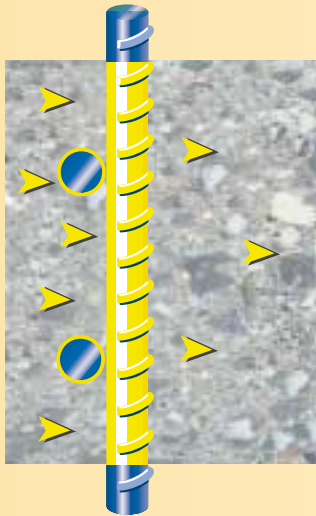


Principles Based on Remediation techniques according to BS EN 1504-9 (BRE digest 444)

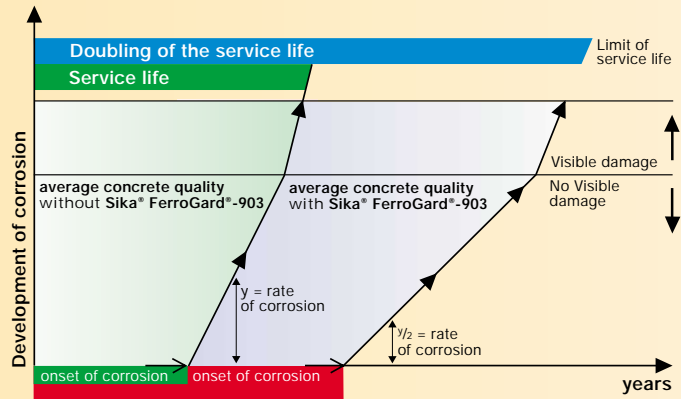
Corrosion protection will be increased by applying Sika® FerroGard®-903 from the beginning, even on concrete surfaces with poor or inadequate concrete cover over the reinforcement.

Principles of cathodic control and anodic control

No further treatment



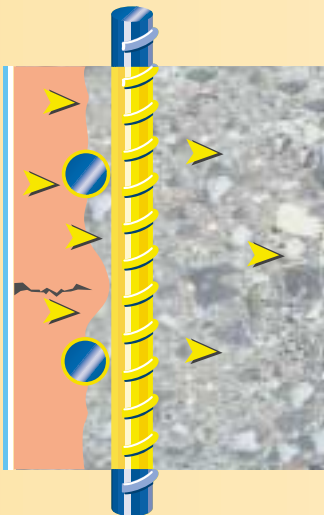
- ▲ Increased corrosion protection
- ▲ Up to double the service life of structures when compared to unprotected structures
- ▲ Concrete properties and aspects will not be changed



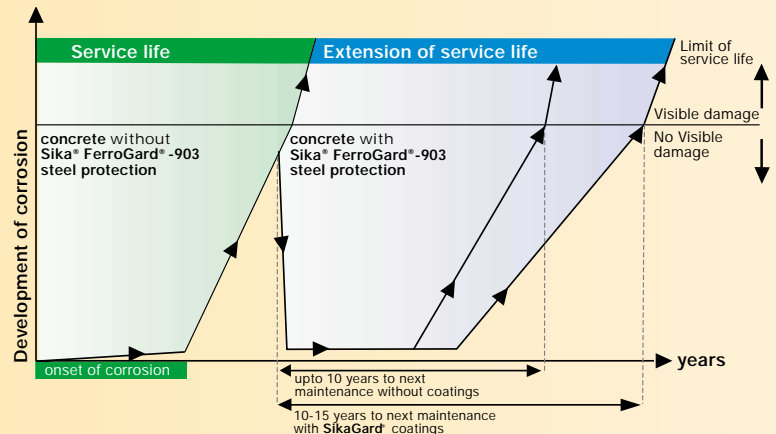
Damage.

Principles of cathodic control and anodic control, increasing concrete resistivity, application of Sika® FerroGard®-903 to protect reinforcement, application of a SikaGard® hydrophobic impregnation or protective coating

SikaGard®

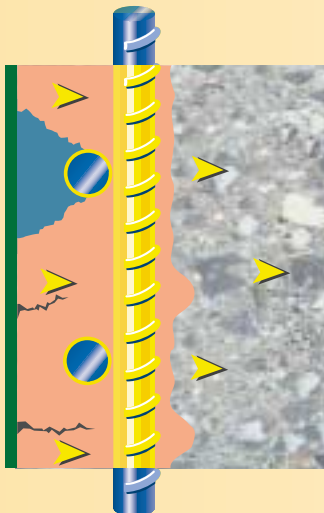


- ▲ This is the last opportunity to protect reinforcement before concrete repairs are required
- ▲ Corrosion process is retarded
- ▲ Increased corrosion protection
- ▲ Protection against water/moisture ingress (coatings)

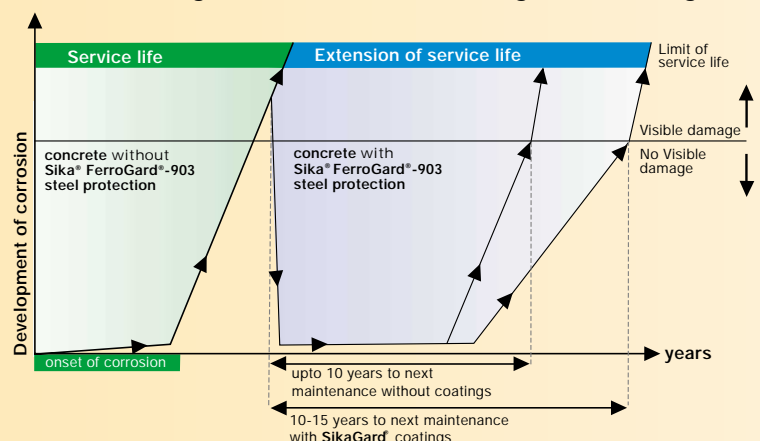


Principles of cathodic control and anodic control, increasing concrete resistivity, application of Sika® concrete air system, application of Sika® FerroGard®-903 to protect reinforcement, application of a SikaGard® hydrophobic impregnation or protective coating

SikaGard®



- ▲ Repair of damaged structure
- ▲ Corrosion process is retarded
- ▲ Increased corrosion protection
- ▲ Protection against water/moisture ingress (coatings)



## Reinforcement Corrosion Control - Bridge.

### Structure/Condition

- ▲ Reinforced concrete bridge structure
- ▲ Chloride induced corrosion to internal and external deck surfaces
- ▲ Localised concrete damage
- ▲ Low concrete cover to reinforcement

### Requirements

- ▲ Reduce active corrosion rates and maintain passive corrosion levels
- ▲ Control corrosion by anodic and cathodic principles
- ▲ Provide up to 10 years additional protection before next maintenance

### Sika Solution

- ▲ Testing to prove penetration of Sika® FerroGard®-903 to depth of reinforcement
- ▲ Clean concrete surfaces
- ▲ Concrete repairs using Sika® MonoTop® mortars
- ▲ Application of Sika® FerroGard®-903
- ▲ Application of SikaGard® 702W Aquaphobe to selected exposed areas



Sika® Qualitative Colour Test Kit for Penetration Depth testing

## Repair and Protection – Building Facade and Stairwells

### Structure/Condition

- ▲ External precast cladding panels carbonated with local concrete damage
- ▲ Chloride contaminated internal stairwells with local concrete damage
- ▲ Low cover to reinforcement. Defective waterproof joints between panels.

### Requirements

- ▲ Limit noise and dust around building
- ▲ Repair, control corrosion, enhance and protect
- ▲ Up to 15 years maintenance free period
- ▲ Maintenance monitoring system
- ▲ Re-sealing of cladding joints

### Sika Solution

- ▲ Clean concrete surfaces
- ▲ Application of Sika® FerroGard®-903
- ▲ Concrete repair with Sika® MonoTop® mortars
- ▲ Application of Sika® Monotop® Levelling mortar
- ▲ Application of SikaGard® 550W Elastic anti-carbonation/protective coating
- ▲ Application of Sikaflex®-1A<sup>+</sup> polyurethane sealant
- ▲ Embedded probes for maintenance monitoring



Corrosion Rate Maintenance Monitoring System Courtesy of C-Probe Technologies



## Repair and Protection – Multi Storey Car Park.

### Structure/Condition

- ▲ Reinforced concrete decks with cracked and spalling concrete
- ▲ Corrosion of reinforcement in carbonated and chloride contaminated concrete

### Requirements

- ▲ Reduce high and low corrosion rates by anodic, cathodic control and concrete resistivity principles
- ▲ Repair cracked and delaminated concrete and protect from future chlorides and carbonation
- ▲ Controlled concrete breakout
- ▲ Minimum 10 years to next maintenance
- ▲ Cost effective solution

### Sika Solution

- ▲ Clean concrete surfaces
- ▲ Application of Sika® FerroGard®-903
- ▲ Concrete repairs and reprofiling with Sika® MonoTop® mortars
- ▲ Application of Protective Deckcoating System
- ▲ Application of SikaGard® 670W anti carbonation protective coating to soffits



## Repair and Protection – Building Facade.

### Structure/Condition

- ▲ Cracked and spalled concrete cladding panels with low concrete cover to reinforcement.
- ▲ Defective waterproof joints between panels
- ▲ Corrosion of reinforcement in carbonated and chloride contaminated concrete

### Requirements

- ▲ Limit noise and disruption to occupants in building
- ▲ Controlled concrete breakout
- ▲ Short repair programme
- ▲ Control corrosion of steel by anodic, cathodic and concrete resistivity principles
- ▲ Up to 15 years maintenance free period
- ▲ Re-sealing of cladding joints

### Sika Solution

- ▲ Depth of penetration and permeability assessment trials to prove suitability of Sika® FerroGard®-903
- ▲ Clean concrete surfaces
- ▲ Application of Sika® FerroGard®-903
- ▲ Concrete repairs with Sika® MonoTop® mortars
- ▲ Application of SikaGard® 550W Elastic anti-carbonation/protective coatings
- ▲ Application of Sikaflex®-PRO 2HP polyurethane sealant



Permeability Testing of Concrete



# Sika® FerroGard®-903

## ▲ Description

Sika® FerroGard®-903 is a unique blend of non toxic, organic and inorganic corrosion inhibitors based on amino alcohol technology, designed for use as an impregnation on hardened reinforced concrete.

Sika® FerroGard®-903 is a multi-functional inhibitor which controls the cathodic and anodic reactions. This dual action effect significantly retards both the onset and the rate of corrosion and increases the time to future maintenance.

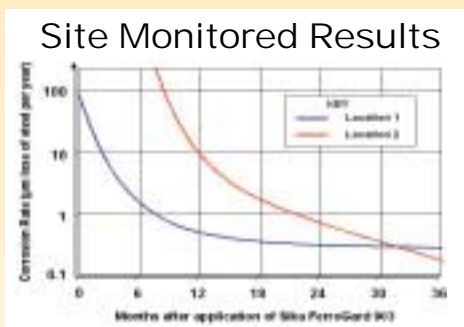
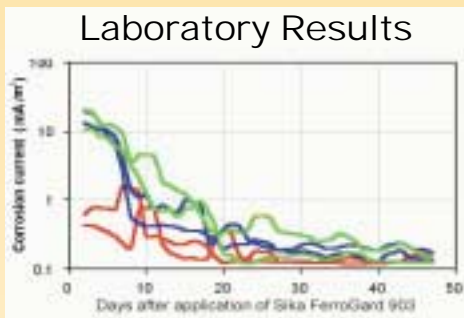
Sika® FerroGard®-903 is normally applied as part of a corrosion management strategy. It is compatible and a component of all the Sika® concrete repair and protection systems.

## ▲ Performance and Durability

Sika® FerroGard®-903 penetrates the concrete and forms an adsorbed protective film on the surface of the steel reinforcement.

This protective adsorbed film of Sika® FerroGard®-903 reduces the rate of corrosion in carbonated and chloride contaminated concrete which has been proven in the laboratory and on site.

Reducing the Rate of Corrosion



## ▲ System Application

### ▲ APPLICATION TRIALS

Penetration depth testing can confirm presence at steel

### ▲ APPLICATION PROCEDURE

Clean and prepare concrete surfaces

Carry out concrete repairs

Apply Sika® FerroGard®-903 to concrete surfaces

Apply Sika® levelling mortar / pore filler

Apply SikaGard® protective coatings

## ▲ Penetration Depth Testing and Quality Control




For Sika® FerroGard®-903 to form an adsorbed protective film on the steel reinforcement the material must penetrate through the cover concrete. Tests prove that Sika® FerroGard®-903 penetrates concrete of varying permeability values.

The Sika® «Qualitative Colour Test» conducted on site can detect the depth of Sika® FerroGard®-903 from concrete samples extracted from the structure.

The Sika® «Qualitative Colour Test» can also be used as a quality control test during the contract.



The Sika® «Qualitative Colour Test» kit.

			
<b>Reference Spot</b> Sika® FerroGard® Solution	<b>No</b> Sika® FerroGard® Solution	<b>Core 1</b>	<b>Core 2</b>

Example of a Sika® FerroGard®-903 «Yes/No-Test» results. Sika® FerroGard®-903 identified at the depth of the steel in the concrete.

Note: For complete product information refer to Sika® FerroGard®-903 data sheet.

The information, and, in particular, the recommendations relating to the application and end-use of Sika products, are given in good faith based on Sika's current knowledge and experience of the products when properly stored, handled and applied under normal conditions. In practice, the differences in materials, substrates and actual site conditions are such that no warranty in respect of merchantability or of fitness for a particular purpose, nor any liability arising out of any legal relationship whatsoever, can be inferred either from this information, or from any written recommendations, or from any other advice offered. The proprietary rights of third parties must be observed. All orders are accepted subject to our current terms of sale and delivery. Users should always refer to the most recent issue of the Technical Data Sheet for the product concerned, copies of which will be supplied on request.

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Environmental



Protection

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Production