Sika® FerroGard® 903

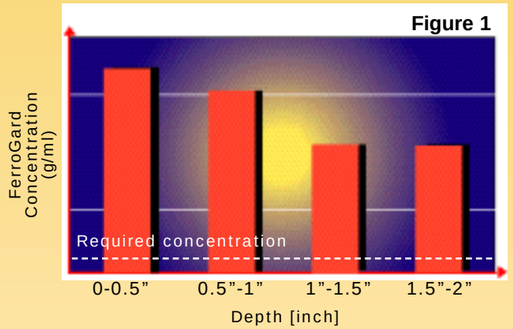
Assessing Performance on the Jobsite:

Penetration Depth

Tests to determine the actual penetration depth of Sika® FerroGard® 903 may be conducted on site. Color indicators show presence of the inhibitor at various depths (see Figures 1 and 2).

Typical penetration depth profile in 3500psi concrete

Figure 1



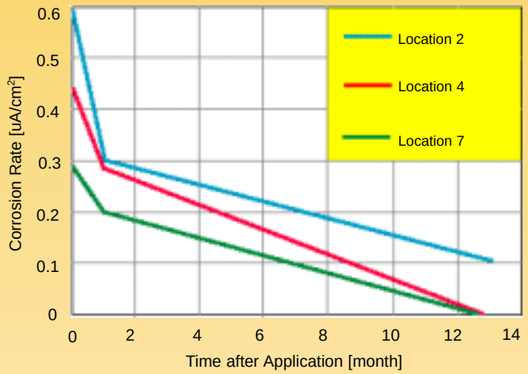
Color Indicator Test on Concrete Cores

Figure 2

Sample of color indicator using on-site gas chromatography to detect presence of Sika® FerroGard® 903 in concrete cores.

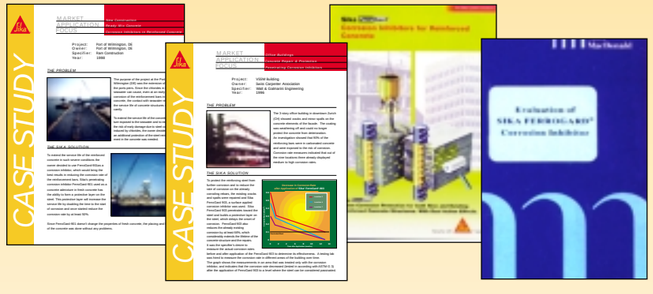
Corrosion Monitoring

The effect of Sika® FerroGard® 903 can be monitored in the field by measurements of corrosion rate using linear polarization techniques:



Example of monitoring the corrosion current after the application of Sika® FerroGard® 903 on the job site.

Additional information regarding Sika® FerroGard® Technology.



Contact Sika At:
Phone: 1-800-933-SIKA NATIONWIDE
Internet: www.sikausa.com
Fax Back: 740-375-0063

Sika Corporation (USA)
201 Polito Avenue
Lyndhurst, NJ 07071
Phone: 201-933-8800
Fax: 201-933-6225

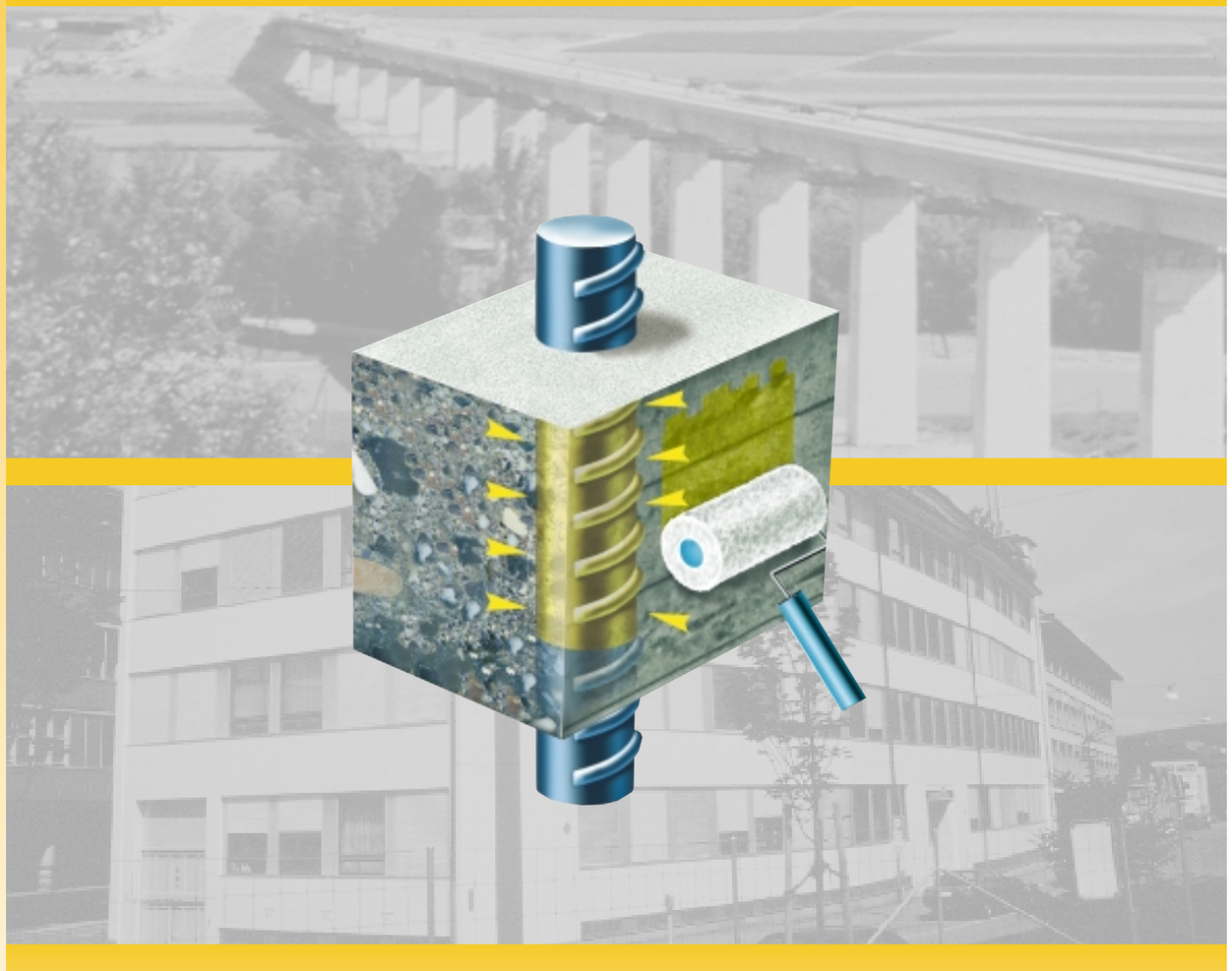
Sika Mexicana S.A. de C.V.
Carretera Libre Celaya Km. 8.5
Corregidora, Queretaro
C.P. 76920 A.P. 136
Phone: 52 42 25 0122
Fax: 52 42 25 0537

Sika Canada, Inc.
601 Delmar Avenue
Point Claire,
Quebec H9R4A9
Phone: 514-697-2610
Fax: 514-694-2792

SIKA...INNOVATIVE SOLUTIONS FOR A CONCRETE WORLD™

Sika® FerroGard® 903

Surface-applied, penetrating corrosion inhibitor for reinforced concrete



- ▲ Delays the onset of corrosion
- ▲ Reduces the rate of corrosion
- ▲ Extends the service life

Corrosion in reinforced concrete structures

Aggressive influences on reinforced concrete

In reinforced concrete, due to the high alkalinity of the concrete (pH 12.5 to 13.5) a stable passivation layer protects the steel from corrosion. However the ingress of aggressive environmental influences can lead to steel corrosion.

Three conditions must exist for reinforcing steel to corrode:

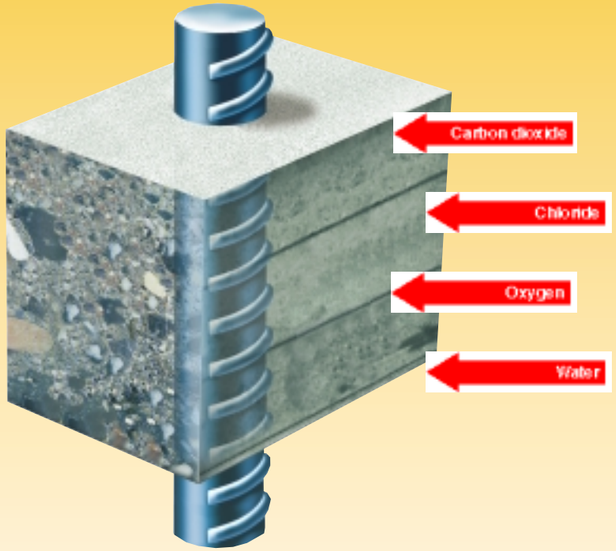
- ▲ The passivation layer of the steel must have been damaged by chlorides or by carbonation of the concrete
- ▲ The presence of moisture as an electrolyte
- ▲ The presence of oxygen

Carbonation

Carbon dioxide ingress causes carbonation of the cement matrix, progressively reducing the pH-value of the concrete. The passivation layer of the steel is destroyed and corrosion of the reinforcing bars can occur.

Chlorides

Chloride ions from deicing salts or marine environments penetrate into the concrete. When the ions reach the steel surface they destroy, even in high alkaline concrete, the passivation layer locally, which leads to accelerated corrosion.



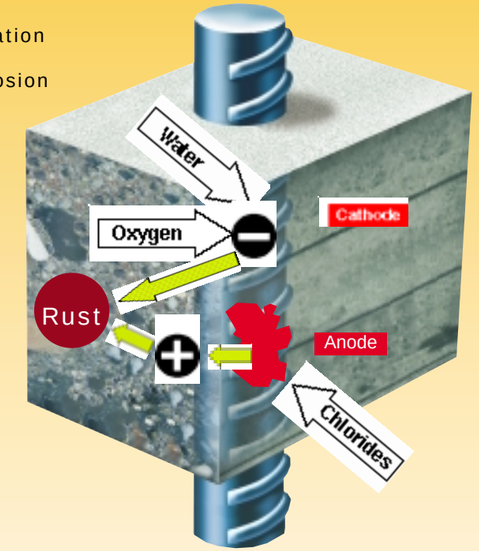
The effect of these aggressive influences

As soon as sufficient chloride ions (from deicing salts or marine environments) and/or the carbonation front have reached the surface of the reinforcing steel, the passivating layer is damaged and corrosion can start.

In presence of water and oxygen a corrosion cell is created on the reinforcing steel.

The corrosion of the steel involves iron changing into iron hydroxide, several times larger than the original iron. The reinforcing bars “expand” which leads to concrete damage (cracking, staining, spalling).

Conditions for corrosion of the reinforcing bars and damage of the concrete are established.



Corrosion Management with Sika® FerroGard® Technology

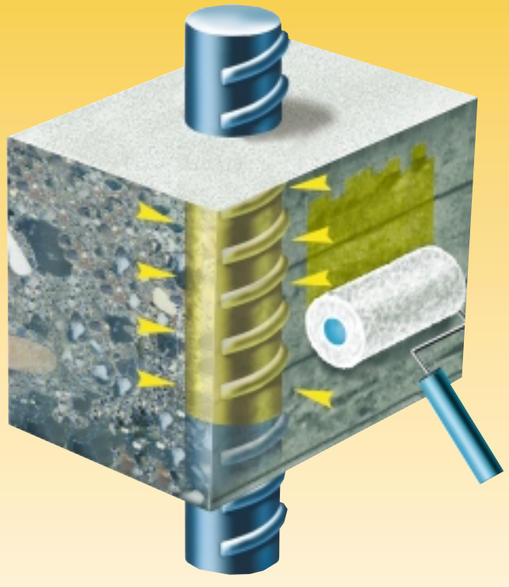
Application of Sika® FerroGard® 903

Sika® FerroGard® 903 is applied as an impregnation onto the surface of the concrete. The corrosion inhibitors penetrate into the concrete and protect the reinforcing bars by forming a protective layer on the steel surface.

Sika® FerroGard® 903 is a clear colorless liquid which does not alter the appearance of the concrete.

Sika® FerroGard® 903 penetrates rapidly into the concrete and reaches the surface of the steel by three different transport mechanisms:

1. During application of Sika® FerroGard® 903 transportation is mainly by capillary suction (like water).
2. Sika® FerroGard® 903 is later carried in solution by the penetration of water and diffusion (like chlorides).
3. Sika® FerroGard® 903 with its high vapor pressure, also travels by gas diffusion (like carbon dioxide).



The performance of Sika® FerroGard® 903

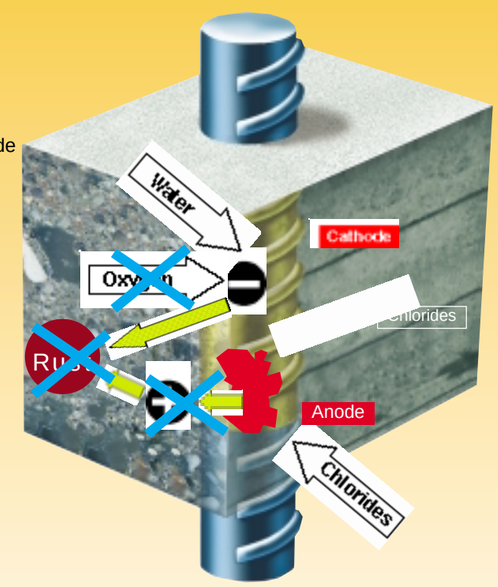
Sika® FerroGard® 903 attaches to the reinforcing steel (by adsorption) and forms a protective layer on the surface, even in carbonated and/or chloride-contaminated concrete (up to 1% chlorides by weight of cement).

Sika® FerroGard® 903 has been proven to displace chloride ions at the steel surface.

The dual inhibiting action of Sika® FerroGard® 903:

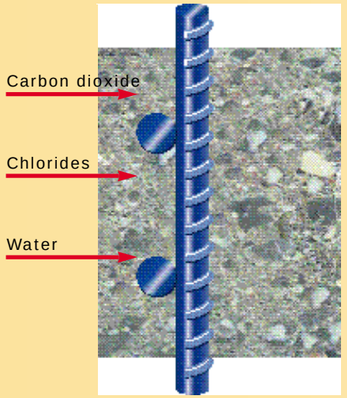
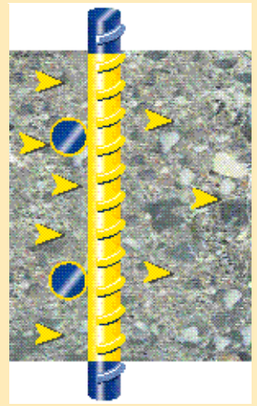
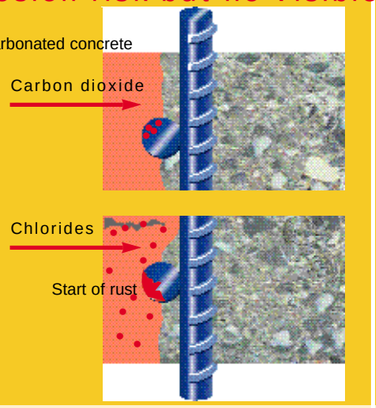
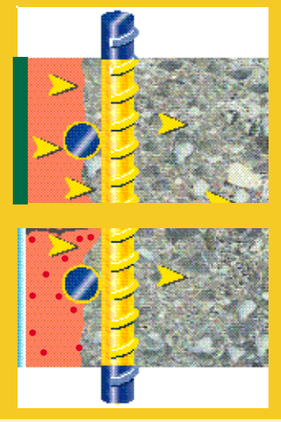
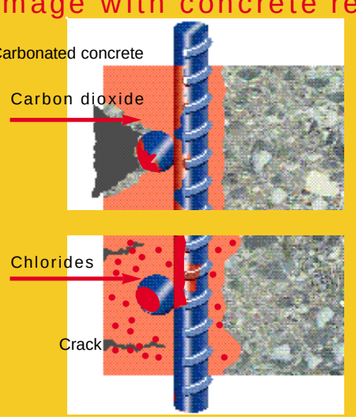
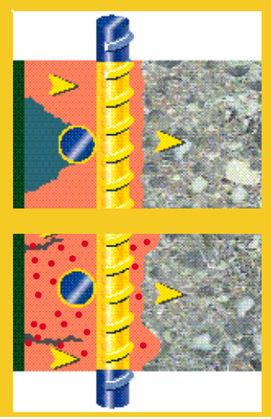
- ▲ The dissolution of the iron is reduced by the protective layer, which inhibits the anodic corrosion reaction.
- ▲ The protective layer reduces the access of oxygen to the steel surface, thus inhibiting the cathodic corrosion reaction.

Sika® FerroGard®-903 delays the beginning of the corrosion process and reduces, once started, the corrosion rate.



Know The Condition Of The Structure

A condition survey must be done before determining the appropriate use of Sika® FerroGard® 903

	Condition of Structure	Objectives and Requirements	Sika® FerroGard® 903 Protection Concept	Key Results and Benefits
STAGE 1	**New structure** New concrete i.e. cast-in-place concrete, severe exposure. ▲ Insufficient concrete coverage of the reinforcing steel and/or honey-combing, bugholes, etc. ▲ Highly aggressive environment 	▲ Protection from premature corrosion ▲ Preservation of the natural concrete appearence	Corrosion protection will be increased by applying Sika® FerroGard® 903 from the beginning, even to concrete surfaces with cracks, honeycombs or inadequate concrete cover over the reinforcement. 	➡ Low cost protection over service life ➡ Preserves natural concrete apearance **Can double the service life of many new structures**
STAGE 2	**Well advanced corrosion risk but no visible corrosion damage** Concrete building or civil engineering structure without protective coating ▲ Steel reinforcement in an aggressive environment ▲ Perhaps light corrosion already exists ▲ No visible corrosion damage 	▲ Protection against possible concrete damage ▲ Protection against further steel corrosion, due to carbonation and/or chloride penetration	Application of Sika® FerroGard® 903 to the concrete surface followed by: 1. Application of an additional Sikagard® anti-carbonation coating or 2. Application of an additional Sikagard® Penetrating sealer 	➡ Minimal or no concrete removal (Saves Money!) ➡ Much less disruption and faster project completion **Can be 10 times less costly than a full STAGE 3 repair**
STAGE 3	**Visible corrosion damage with concrete repair necessary** Concrete surface (building or civil engineering structure) without coating but with visible corrosion damage i.e. spalling concrete, cracks, etc., concrete repair necessary ▲ Level of chlorides at the depth of the steel is a maximum of 1% by weight of cement (5-6lbs./yd^3) 	▲ Repair of damaged concrete surfaces ▲ Long term protection against future environmental influences ▲ Enhanced protection against the continuing damage of latent corrosion ▲ Reduced potential of incipient anode corrosion	1. Application of Sika® Armatec 110 EpoCem® bonding layer/anti-corrosion coating 2. Application of SikaTop® *Plus* repair mortar 3. Application of Sika® FerroGard® 903 4. Application of Sikagard® protective coating 	➡ Restores structure to a safe condition with improved aesthetics ➡ Complete repair and protection system protects against latent damages **Can more than double the repair life expectancy** (Based on ASTM G109 testing)

Sika® FerroGard® 903 Case Studies

Repair & Protection – Parking Garage

Structure/Condition
- ▲ Parking garage with chloride contaminated concrete (max. 1% by weight of cement or 5-6lbs./yd^3)
- ▲ Structural cracks in concrete slab
- ▲ Damaged concrete

Requirements
- ▲ Structural repair of the cracks
- ▲ Protection of the reinforcing steel against latent corrosion damage due to chlorides

Sika Solution
- ▲ Crack injection with Sikadur® 31 and Sikadur® 35 epoxies
- ▲ Spray application of Sika® FerroGard® 903
- ▲ Full-depth repair of some concrete with Sika® FerroGard® 901 as an admixture

Repair and Protection – Hi-Rise Buildings Facade

Structure/Condition
- ▲ Reinforcing steel in carbonated concrete
- ▲ Spalling and cracking of the concrete

Requirements
- ▲ Repair and protection of concrete facade
- ▲ Durable repairs

Sika Solution
- ▲ Removal of the damaged concrete.
- ▲ Application of Sika® Armatec 110 Epocem® as bonding layer
- ▲ Reprofiling with SikaTop® *Plus* repair mortars
- ▲ Joint sealing with Sikaflex® 1a sealant
- ▲ Application of Sika® FerroGard® 903
- ▲ Application of Sikagard® 550W Elastic and Sikagard® 670W anti-carbonation/protective coatings

Repair and Protection – Building Facade and Balconies

Structure/Condition
- ▲ Insufficient concrete cover over reinforcing steel
- ▲ Reinforcing steel in carbonated concrete
- ▲ Cracking and spalling of the concrete

Requirements
- ▲ Durable repair of the damaged concrete
- ▲ Improved appearance of the repaired facade and balconies

Sika Solution
- ▲ Removal of the damaged concrete
- ▲ Application of Sika® Armatec 110 EpoCem® as bonding layer
- ▲ Reprofiling with Sika® MonoTop® repair mortar
- ▲ Application of Sika® FerroGard® 903 delays the onset of corrosion and reduces the risk of incipient anodes

Facade:
- ▲ Application of crack bridging Sikagard® 550W Elastic protective, anti-carbonation coating

Balconies:
- ▲ Application of crack bridging Sikafloor® 450/455 (Pedestrian duty) Waterproof deck coating

Repair and Protection - Bridge Overpass

Structure/Condition
- ▲ Leaking Cracks through the bridge deck
- ▲ Chloride contaminated concrete (max. 1%by weight of cement or 5-6lbs./yd^3)
- ▲ Spalling and cracking of the concrete

Requirements
- ▲ Eliminate the root cause of the water leakage
- ▲ Repair and protection of the concrete bridge structure

Sika Solution
- ▲ Removal of the damaged concrete
- ▲ Application of Sika® Armatec 110 EpoCem® as bonding layer
- ▲ Application of Sikacem® spray-applied repair mortars in the repair areas
- ▲ Application of Sika® FerroGard® 903 for the whole concrete structure
- ▲ Sealing of expansion joints with Sikaflex® 2C sealant
- ▲ Application of Sikagard® 670W protective coating