EVONIK INDUSTRIES

Protectosil® CIT

Corrosion Inhibitor Treatment for steel reinforced concrete

Protectosil® CIT

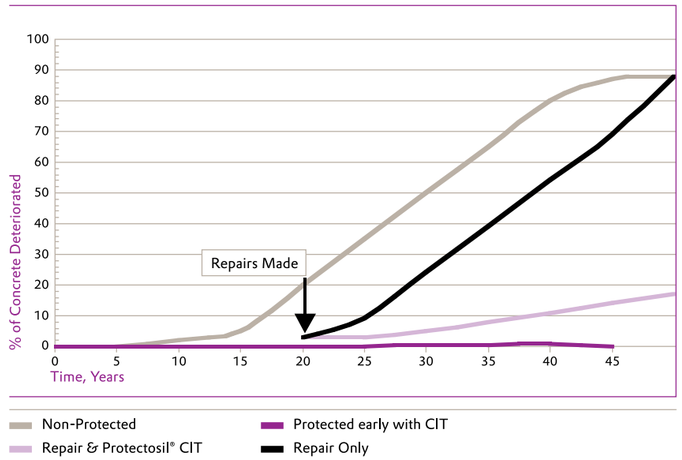
Evonik. Power to create.

Because the best repair is the one that never has to be done.

Corrosion, simply defined, is the deterioration of metal components. It's a naturally occurring process that would appear harmless to most people. However, to owners of steel reinforced concrete structures, it's a nightmare. Buildings, bridges, parking decks and condominiums are major private and public investments that all can succumb to the deteriorating effects of corrosion.

Corrosion of concrete's reinforcing steel is a serious problem leading to cracks, spalls, leaks and falling concrete. The ramifications of these problems are: structural failure, collapse, expensive repairs, and legal liability. Repairing damage alone is not sufficient. The underlining corrosion will continue to cause future damage. Protectosil® CIT can reduce corrosion at a fraction of the cost of future repairs.

Extension of Service Life Due to Protectosil CIT® Treatment



Protectosil® CIT Protects From Within

Protectosil® CIT actively protects steel reinforced concrete in two distinct ways:

- reduces active corrosion
- protects against ingress of water-borne chlorides

Even in concrete exposed to high corrosion conditions, Protectosil® CIT provides long-lasting protection. Protectosil® CIT is an innovative patented organofunctional corrosion inhibitor from Evonik with outstanding features:

- Suitable for cast-in-place, precast and high performance concrete
- Easy (spray on) application
- Effective in structures with elevated chloride content
- Effective in high humidity conditions
- Proven to reduce active corrosion by more than 90%
- Stops corrosion due to the ring anode or "halo effect"

Content

Tests performed on steel reinforced columns (pictured left) at the entrance of the gallery of Cianca Presella located on the Swiss Highway A13

Protectosil® CIT interrupts the mechanism of corrosion

Corrosion occurs when the steel becomes unstable or in electrochemical terms non-passive. Generally, steel in concrete is very stable, but environmental influences such as chloride ions from deicers, sea water, or the carbonation of the concrete all cause the reinforcement to become unstable. At this point corrosion is a simple electrochemical reaction between the steel, moisture and oxygen.

Protectosil® CIT acts efficiently against both aspects of corrosion:

- Protectosil® CIT's proprietary organofunctional chemistry interrupts the electrolytic current, causing the steel to repassivate itself and to substantially decrease the corrosion and its byproduct rust
- Protectosil® CIT provides a deeply penetrating barrier that prevents additional water and chloride ions from reaching the rebar

The result: A dramatic decrease in corrosion!

Protectosil® CIT has been proven by independent test agencies to reduce active corrosion

Field Study: NACE reports a clear decrease in corrosion

Protectosil® CIT was compared with other corrosion inhibitors to test their effectiveness in reducing corrosion currents and the repassivation of steel on concrete columns. NACE reported that, "The Protectosil® CIT treatment resulted in a clear decrease in corrosion current, and even repassivation is observed on the sensors initially showing active corrosion." (NACE Materials Performance, October 2006)

Lab Study: FHWA Corrosion Performance Tests on Cracked Concrete

The effectiveness of Protectosil® CIT and other corrosion inhibitors was documented using the rigorous FHWA RD-98-153 protocol. To measure the inhibitor's ability to reduce corrosion resistance, the protocol spanned two years and consisted of weekly salt water ponding on reinforced concrete specimens with transverse cracking.

Protectosil® CIT was applied to the surface of cracked concrete specimens and after 48 wet dry cycles, the results demonstrated that Protectosil® CIT ranked exceptionally high in the test over competitors and was 99% effective in preventing corrosion.

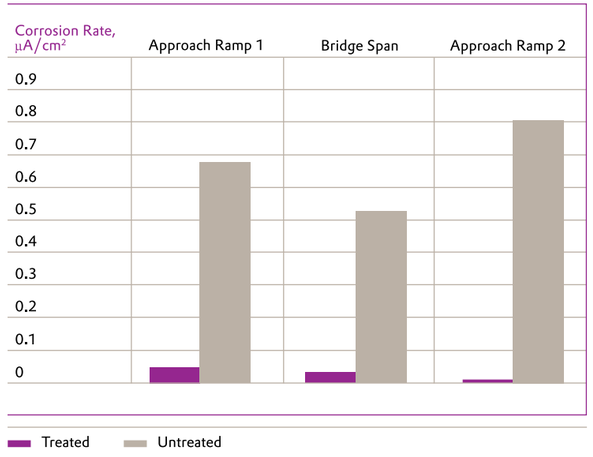
Percent Corrosion Improvement

* Photos of spraybar application on the bridge span of the Commodore Barry Bridge.

Field Study: Commodore Barry Bridge (US 322)

Transporting over 35,000 vehicles per day across the Delaware river, the Commodore Barry Bridge, represents a major passageway linking Southeastern Pennsylvania & Southern New Jersey. In 2001, the Delaware River Port Authority approached Evonik Corporation to rehabilitate the bridge which showed signs of corrosion damage due to chloride ion ingress and transverse cracking. After analytical testing confirmed the amount of corrosion present, Protectosil® CIT was then specified to treat 1,000,000 square feet of the bridge deck and all its approaches.

Corrosion Measurements 1997-2007, Commodore Barry Bridge



Protectosil® CIT Saves You Money

Protectosil® CIT's protection system not only protects the rebar from corrosion and chlorides, but it also protects your assets. By reducing repair costs and increasing the service life of your structure Protectosil® CIT can save you substantial money.

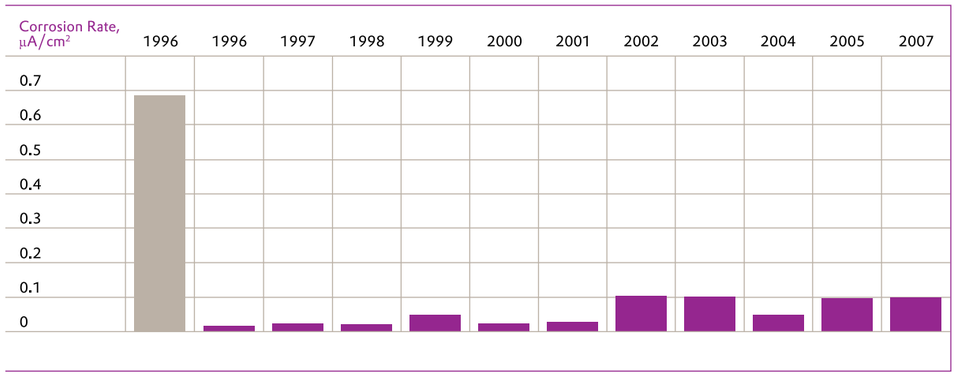
Additional Cost Savings Facts

- Corrosion repairs costs run between $80 to $100 per sq. foot
- Repairs result in lost revenue due to structural down time
- Protectosil® CIT costs less than competing corrosion reduction strategies
- Cost payback is normally less than 3 years

Case Study: Monroe County Parking Facility, Monroe, PA

The long term benefits of Protectosil® CIT have been demonstrated on a four level parking structure in Monroe, Pennsylvania. In 1996, Protectosil® CIT was applied to remediate corrosion problems that were present such as high corrosion current and delamination. Each year corrosion measurements have been performed at the site since the application to check and ensure the effectiveness of the inhibitor. Each annual test has verified that Protectosil® CIT is working.

Field Performance of Protectosil® CIT: Parking Structure Exposed to Deicer Salts



Protectosil® CIT Penetrates to the Steel Reinforcement

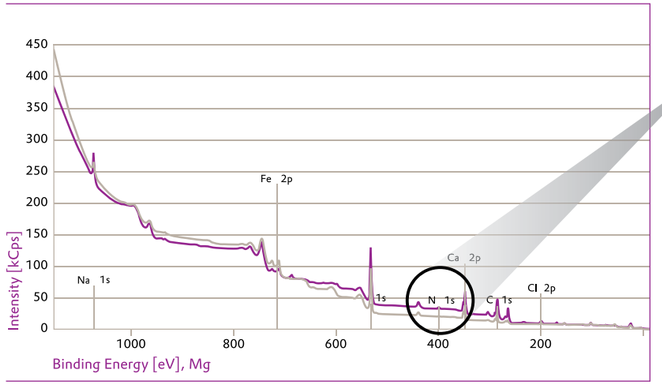
Analysis of steel reinforcement proves that Protectosil® CIT penetrates and forms a chemical bond to the steel. X-Ray Photoelectron Spectroscopy (XPS) studies of steel extracted out of concrete treated with Protectosil® CIT clearly show the chemical changes imparted by the inhibitor. XPS is a quantitative spectroscopic surface chemical analysis technique. It's often used to measure elemental composition on surfaces of a material, including steel. The detection limit for most elements using XPS is 100 ppm to 1000 ppm. The charts below are XPS results. (Aqura Analytical Solutions)

Autopsies of steel reinforced concrete specimens after 520 days of cyclic salt water exposure

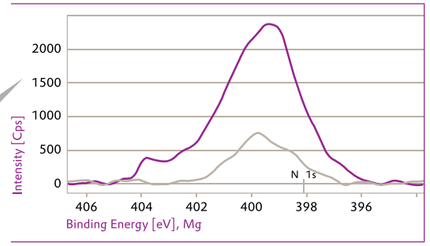
Protectosil® CIT

Amino alcohol/carboxylate inhibitor

Protectosil® Penetration and Bonding to Steel Reinforcement



Amine component of Protectosil® CIT



Properties	Protectosil® CIT	Amino alcohol/carboxyl based	Silicate based
Typical Active Content	100%	30% to 35%	10% to 15%
Low Viscosity, Low Surface Tension (<water)	Yes	No	No
Application Temperature	20°F to 100°F	35°F to 100°F	40°F to 100°F
Chemically Bonds to Substrate	Yes	No	No
Corrosion Reduction via ASTM G109	>90%	0 to 65%	0%
Corrosion Reduced at > 90% RH & 100°F	Yes	No Data	No Data
Corrosion Reduction with 15 mil micro-cracks (FHWA –RD-98-153)	>90%	No Data	No Data
Max. Chloride Ion Content per Cement Weight	4% to 6%	1% to 2%	No Data
Reduces Additional Chloride Penetration	Yes	No	No
Penetrates/Reduces Corrosion in Concrete Previously Treated w/Repellents or Inhibitors	Yes	No	No
Weather Resistant/Water Insoluble	Yes	No	No
Corrosion Based Warranty	Yes	No	No

Protectosil® CIT has extensive laboratory and field data to support its exceptional performance. Advantages over competing technologies include:

- Longer service life
- Combines inhibitor and secondary sealer
- Compatible with subsequent caulking or coatings without additional surface preparation

Protectosil® CIT with Galvanic Protection Systems

Protectosil® CIT can work in conjunction with galvanic protection systems such as embedded galvanic anodes or zinc rich coating systems. Protectosil® CIT works independent of the sacrificial anodes of these systems and enhances their overall performance.

Protectosil® CIT with Corrosion Inhibitor Admixtures and Pozzolans

The use of admixed corrosion inhibitors in patching materials or in the existing concrete will not affect the performance of Protectosil® CIT. The most common admixed inhibitors (calcium nitrite and amine based) do not interfere with the chemical reaction of the Protectosil® CIT. Pozzolans and high strength concrete does not interfere with the penetration of Protectosil® CIT.

Analytical Testing/Quality Control

Analytical Testing for Cost-Saving Corrosion Inhibition

On-site technical analysis is one of the many benefits that Protectosil® CIT has to offer. Our support professionals can evaluate your structure and recommend the right application rate and technique specific to your site.

Other services provided include:

- Corrosion current measurement: *Half-cell & Linear polarization**
- Chloride analysis
- Concrete permeability
- Carbonation measurement
- Analysis for previous surface treatments

*Additionally, we can predict the degree of corrosion reduction you can expect and perform follow up corrosion monitoring to track the performance of Protectosil® CIT.

Fugitive Dyes for Quality Control

Fugitive dyes added to Protectosil® CIT allow workers and inspectors to see exactly where product was applied.

Fugitive Dyes:

- Ensure thorough application
- Prevent product waste
- Lowers labor costs
- Color disappears after 5-7 days

Protectosil® CIT on the Internet

Information, addresses, and contacts

The website **www.protectosil.com** offers a well-structured platform where you can find information on products, methods, and chemical processes. A solution-finder provides informative brochures and presentations for downloading, in addition to product information and safety data sheets.

The database containing details of Evonik contacts and dealers worldwide gives you convenient access at any time to important contact data.

www.protectosil.com

www.evonik.com

Notes

EVONIK INDUSTRIES

Europe / Middle-East / Africa / Latin America

Evonik Resource Efficiency GmbH
Business Line Silanes
Rodenbacher Chaussee 4
63457 Hanau-Wolfgang
Germany

PHONE +49 6181 59-13636
FAX +49 6181 59-13737
protectosil@evonik.com
www.protectosil.com

NAFTA

Evonik Corporation
Business Line Silanes
299 Jefferson Road
Parsippany, NJ 07054
USA

PHONE +1 800 828-0919
FAX +1 973 541-8503
protectosil@evonik.com
www.protectosil.com

Asia / Pacific

Evonik Specialty Chemicals (Shanghai) Co. Ltd.
Business Line Silanes
55, Chungdong Road
Xinzhuang Industry Park
Shanghai 201108, P.R. China

PHONE +86 21 61191 660
FAX +86 21 6119-1075
protectosil@evonik.com
www.protectosil.com

Evonik. Power to create.

RE-25-1-MAR16L+L