



MIGRATING CORROSION INHIBITORS
FROM GREY TO GREEN

MCI® SURFACE APPLIED

CORROSION PROTECTION SYSTEMS FOR REINFORCED CONCRETE



Existing Concrete Structures and the Test of Time

Existing structures are vital for supporting urban life and infrastructure. Bridges, commercial and residential buildings, industrial facilities, sea walls, and more are built to withstand the test of time. However, they are not invincible to the persistent threat of decay and corrosion.

Many factors affect the service life of concrete structures. These include the materials, concrete cover thickness, environmental conditions, structural use, maintenance level, and more.

Reinforced concrete rebar corrosion is a very common cause of degradation, as many sources can contribute to the problem. Structural defects, as well as exposure to corrosives including water, salts, and other contaminants, can accelerate the corrosion of reinforcing metals.

Moreover, repairs that do not address the root cause of the corrosion problem may exacerbate the situation. One example is doing patch repairs only in localized areas where signs of corrosion appear. Applying new concrete patches with a high pH and no chlorides next to older contaminated concrete with rebars running through both materials leads to what is known as the “incipient anode” effect or “ring anode”/ “halo” effect. This happens when the high difference in corrosion potential between the two areas accelerates corrosion on metal reinforcement near the patch.



A thorough assessment of existing problems followed by comprehensive repairs may substantially increase the life expectancy of the affected areas and the overall structure. These steps can also minimize the need for repairs, repair materials, and new construction, ultimately leading to more sustainable practices and lower carbon impacts.

Surface Applied Corrosion Inhibitors

Surface applied corrosion inhibitors (SACIs) have been widely used to address ongoing corrosion problems and extend the service life of existing concrete structures. ICRI Guideline No. 510.2-2019 defines SACIs and explains that they can penetrate cementitious materials and reach the rebar to prevent or slow corrosion reactions on the steel surface.¹

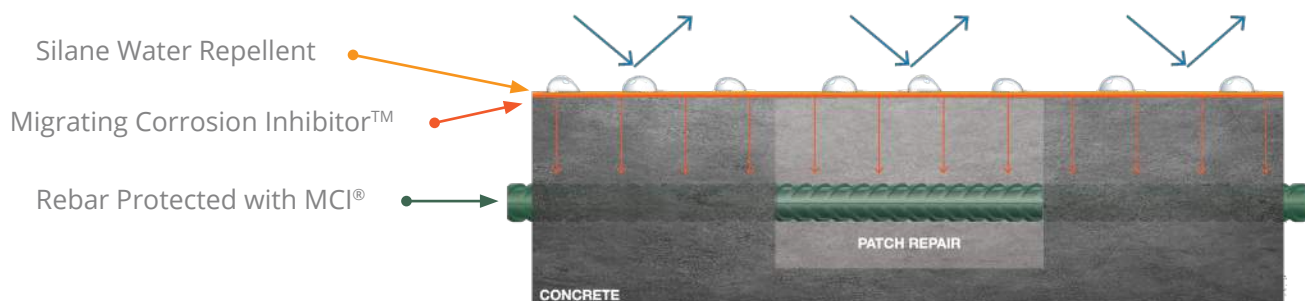
Surface applied corrosion inhibitors help by reducing future corrosion when used as a preventative solution, delaying corrosion onset for steel reinforcement in good condition, reducing active corrosion rates, and slowing down the halo effect of corrosion near repair areas. They effectively increase the service life of structures, offer long-lasting durability, and reduce needs for maintenance.

Cortec® offers several SACI types that are used for different applications:

- Pure (Neat) SACI: Highly concentrated products that are water-based.
- SACI + Water Repellents: Water repellent products that improve concrete's resistance to water penetration while supplying corrosion inhibitors for steel protection.
- SACI + Densifier: Densifying products that improve concrete's resistance to water penetration while supplying corrosion inhibitors for steel protection.

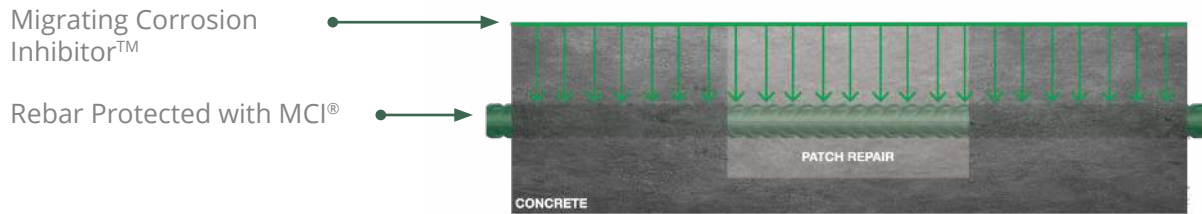
TYPE	PRODUCT	DESCRIPTION	APPLICATION
Pure (Neat) SACI	MCI®-2020 MCI®-2020 M	Water based SACIs.	Existing structures that exhibit signs of reinforcement corrosion. Can be used as a remedial or preventative measure. Ideally, these products can be used in conjunction with a water protection system (sealer, membrane, or water repellent). These products are commonly used in parking garages, bridges, seawalls, and historical structures.
	MCI®-2020 V/O MCI®-2020 M V/O	Water based SACIs for vertical and overhead applications.	
	MCI®-2020 M SC MCI®-2120	Concentrated SACIs.	
SACI + Water Repellent	MCI®-2018 MCI®-2019	Silane based water repellent with SACIs.	Existing structures that are exposed to salt and water (e.g., parking garages, retaining walls, walkways, exterior staircases, seawalls, and more). Not suitable for hydrostatic pressure.
	MCI®-2022	Silane/siloxane based water repellent with SACIs.	Porous substrates such as brick, sandstone, and vertical walls. May darken surfaces and increase slippage.
SACI + Densifier	MCI®-2021	Silicate based densifier with SACIs.	Old structures that have lost some strength and suffer from erosion and dusting/chalking.

MCI®-2018: 100% Silane Sealer & Corrosion Inhibitor



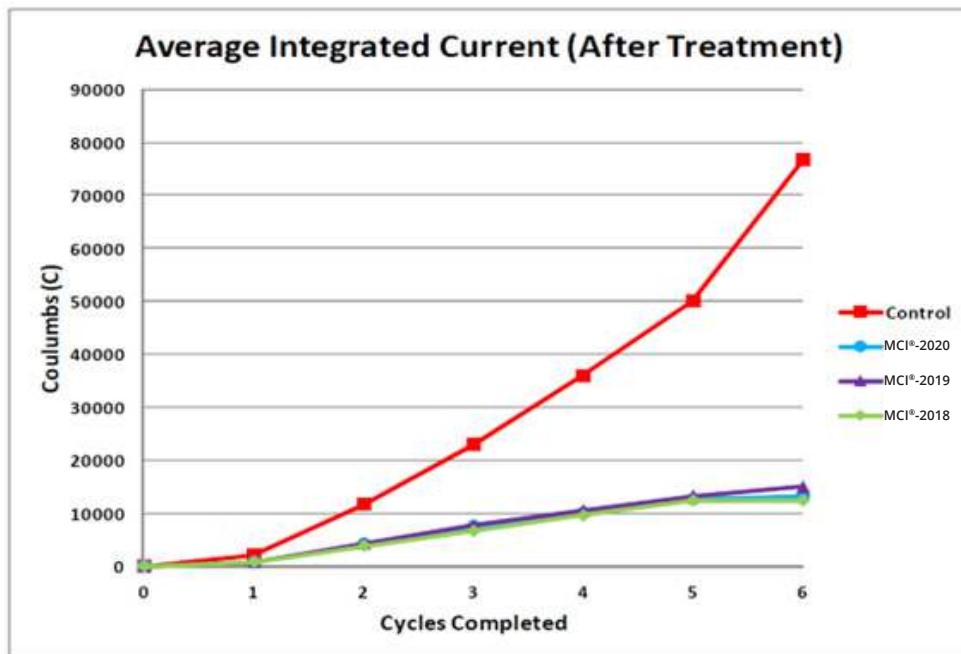
¹ ICRI Guideline No. 510.2-2019, "Guideline for Use of Penetrating Surface Applied Corrosion Inhibitors for Corrosion Mitigation of Reinforced Concrete Structures," 2019, p. 1.

MCI®-2020: Pure Corrosion Inhibitor (High Concentration)



USBR M82 Testing

The U.S. Bureau of Reclamation M-82 (M0820000.714) Standard Protocol to Evaluate the Performance of Corrosion Mitigation Technologies in Concrete Repairs was followed to evaluate the performance of MCI® SACI products in mitigating ongoing corrosion in reinforced concrete slabs. Test results confirmed that the SACI products were effective and reduced total average integrated current by five times.



The Efficacy of Using Migrating Corrosion Inhibitors (MCI®-2020 & MCI®-2020 M) for Reinforced Concrete

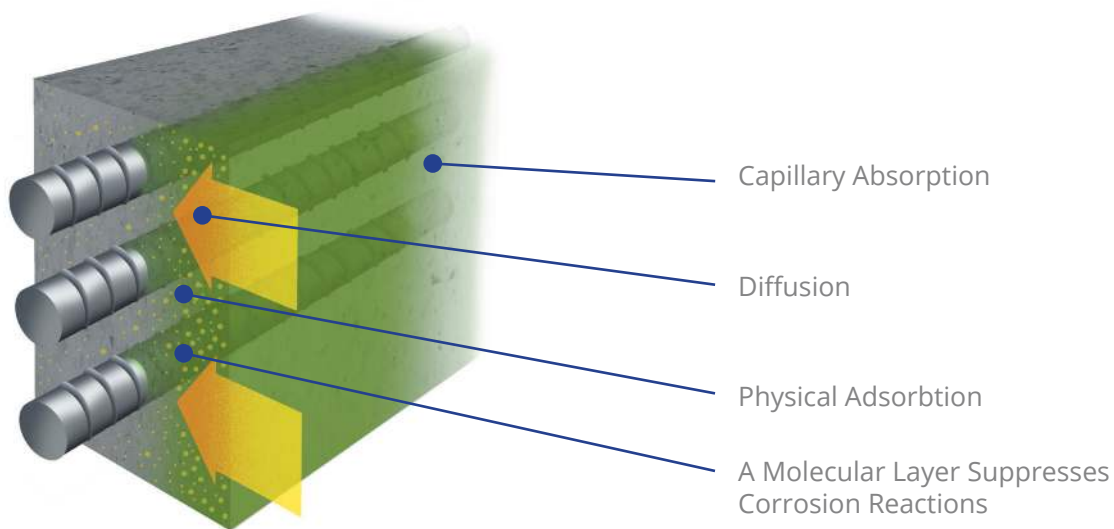
B. Bavarian, PhD., L. Reiner

March 2004

MCI®-2020 and MCI®-2020 M were analyzed for their ability to migrate, form a protective film, and mitigate corrosion on embedded reinforcement. Key findings were as follows:

- MCI® protected samples had an average current density of $0.4 \mu\text{A}/\text{cm}^2$ compared to $1.4 \mu\text{A}/\text{cm}^2$ for untreated samples, increasing the service life expectancy by more than 15-20 years.
- XPS depth profiling showed that MCI® inhibitors were able to adsorb deeper (nitrogen marker detected as deep as 85 nm for the MCI®-2020 M unetched sample and as deep as 75 nm for the MCI®-2020 unetched sample) than the chloride ions (60 nm), providing a protective film. Untreated samples had localized corrosion attack.

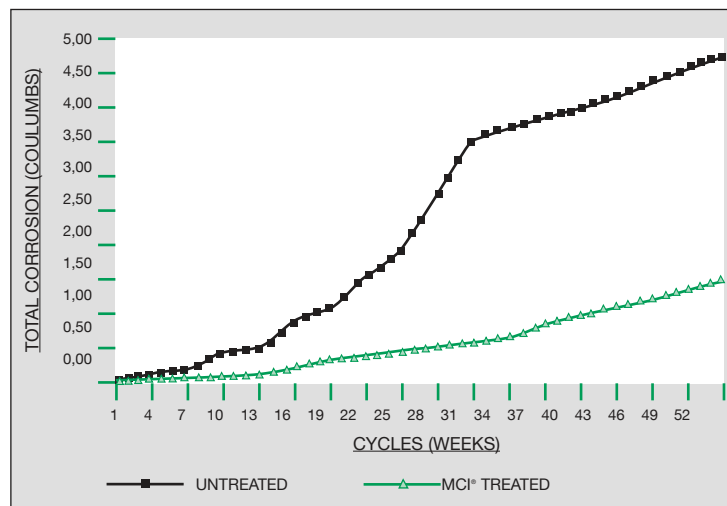
MCI® TRANSPORT MECHANISMS IN CONCRETE



Testing the Effectiveness of Migrating Corrosion Inhibitor™ MCI®-2020 on the Corrosion of Reinforcing Steel

Prof. Dr. Dubravka Bjegovic, Zagreb University, Croatia

ASTM G109 testing was performed on a control and MCI®-2020 treated concrete specimens. After one year of testing, MCI®-2020 treated samples had four times less total corrosion than the control specimens.



Pentagon Wall Restoration

Carbonation of Pentagon lightwell walls was causing corrosion of embedded reinforcing steel, which led to concrete spalling. A repair was needed that would meet a 50-year minimum design life, stop water absorption, reduce or stop corrosion, and have little to no effect on the structure's appearance. As part of the plan, and in accordance with ICRI guidelines, the engineer selected MCI®-2020 V/O for application over the entire repair surface of 1,000,000 ft² (92,903 m²), followed by a 100% silane water repellent and a water resistant potassium silicate coating, each of which provided a 20-year warranty. In 2023, MCI®-2020 V/O reached its 20th anniversary of application with no callbacks.



Enhancing Service Life of Pelješac Bridge

The Pelješac Bridge, which connects two separate parts of Croatia, is exposed to a corrosive environment. Because of the project's goal of reaching a 130-year service life in such harsh conditions, the designer specified a combined approach to corrosion protection. In addition to the use of AC coatings, cathodic protection, a thick concrete cover, and stainless steel reinforcement, MCI®-2018 was chosen for application to the entire substructure. This offered dual water-repellency and corrosion inhibition through the presence of Migrating Corrosion Inhibitors in a 100% silane base.



Full Corrosion Protection Systems

Corrosion problems are always tricky and SACIs may need to be supplemented with other solutions and protection systems.

Rust Converting Primer

CorrVerter® MCI® Rust Primer is a water based primer recommended for application on rusty or poorly prepared steel surfaces where corrosion protection is required and good surface preparation is difficult to achieve. CorrVerter® MCI® penetrates and converts rust and passivates the steel to minimize further rust development.

MCI®-2020 Gel

MCI®-2020 Gel can be used to protect metals that are deeply embedded in concrete and to bypass any cladding or paint that cannot be stripped or removed.

Primer and Topcoat

MCI® EcoRainbow® Architectural Coating is a unique, water based primer/topcoat designed to provide protection in harsh, outdoor applications. The architectural coating provides three main benefits: (1) acts as a sealer, (2) improves appearance, and (3) provides a source of corrosion inhibitors when applied directly to new metal.

Oil Cleaners and Degreasers

MCI®-2061 and MCI®-2062 are powerful cleaners that harness the activity of beneficial microorganisms to safely and effectively provide residual deep cleaning action on oil stains on concrete and other substrates. They can save time and money while providing deep cleaning action that does not erode the substrate.

MCI® Repair Mortars

MCI® repair mortars are high-performance mortars with integral Migrating Corrosion Inhibitors. The incorporation of corrosion inhibitors into the dry material can increase repair service life, reduce the incipient anode effect, and save time by eliminating the possibility of dosing mistakes when the corrosion inhibitor is added on site.

Product Selection Guide

	Product	Description	Approximate Dosage Rate	Packaging
Amine Carboxylate Based	MCI®-2020 MCI®-2020 V/O	Clear, penetrating surface treatment for existing structures. Contains Migrating Corrosion Inhibitors that form a protective film on embedded metals. Certified to meet ANSI/NSF Std. 61 for drinking water system components. V/O version is for vertical and overhead applications.	150 ft ² /gal (3.68 m ² /L)	5 gal (19 L) pails 55 gal (208 L) drums
	MCI®-2020 M MCI®-2020 M V/O	Modified version of MCI®-2020 for better corrosion protection and less impact on adhesion.	150 ft ² /gal (3.68 m ² /L)	5 gal (19 L) pails 55 gal (208 L) drums
	MCI®-2020 M SC	Concentrated version of MCI®-2020 M. Dilute 1:1 with water to make ready to use product.	150 ft ² /gal (3.68 m ² /L)	5 gal (19 L) pails 55 gal (208 L) drums
Water Repellents with MCI®	MCI®-2018 MCI®-2018 V/O	100% solids, organosilane water repellent containing MCI®. Spray, brush, or roller applied.	125-175 ft ² /gal (3-4.2 m ² /L)	5 gal (19 L) pails 55 gal (208 L) drums
	MCI®-2019	VOC compliant, solvent based 40% silane water repellent containing MCI®. Spray, brush, or roller applied.	125-175 ft ² /gal (3-4.2 m ² /L)	5 gal (19 L) pails 55 gal (208 L) drums
	MCI®-2019 W	Water based, 40% silane water repellent containing MCI®. Spray, brush, or roller applied.	125-175 ft ² /gal (3-4.2 m ² /L)	5 gal (19 L) pails 55 gal (208 L) drums
	MCI®-2021	Water based, silicate densifier containing MCI®. Spray, brush, or roller applied. Patented.	150-250 ft ² /gal (3.7-6.1 m ² /L)	5 gal (19 L) pails 55 gal (208 L) drums
	MCI®-2022 MCI®-2022 V/O	Water based, silane/siloxane blend water repellent containing MCI®. Spray, brush, or roller applied. V/O version for vertical and overhead applications. Patented.	125-175 ft ² /gal (3-4.2 m ² /L)	5 gal (19 L) pails 55 gal (208 L) drums
Coatings and Water Repellents	MCI®-2018 X	100% solids, organosilane breathable water repellent without MCI®. Spray, brush, or roller applied.	125-175 ft ² /gal (3-4.2 m ² /L)	5 gal (19 L) pails 55 gal (208 L) drums
	MCI®-2026 Primer WB	Two-component, chemically resistant, water based epoxy primer for concrete.	180-250 ft ² /gal (4.4-6.1 m ² /L)	2.5 gal (8.5 L) and 25 gal (85 L) kits
	MCI®-2026 Floor Coating	Two-component, chemically resistant, 100% solids novolac epoxy for concrete. Excellent chemical and abrasion resistance.	50-125 ft ² /gal (1.23-3.07 m ² /L)	2.5 gal (9.5 L) and 12.5 gal (47 L) kits
	MCI® EcoRainbow® Architectural Coating	Clear, water based, acrylic primer/topcoat containing MCI®. Also available in white, grey, and custom colors.	535-641 ft ² /gal (13-16 m ² /L)	5 gal (19 L) pails 55 gal (208 L) drums

Cortec® Corporation



Quality Management System (ISO 9001 Certified)

World Class Product Offerings

An innovative producer of leading edge products.

World Class Customer Service

A positive, long-lasting impression through every link of our company.

World Class Environmental Commitment

Cortec® commits to continued development of processes and products that are useful, non-hazardous to the environment, and recyclable whenever possible.

An Ethical and Respectful Company Culture

Respect and treat our colleagues, customers, and vendors as we would our own family members.



Environmental Management System (ISO 14001 Certified)

Cortec's strong environmental concern is demonstrated in the design and manufacturing of products that protect materials of all kinds from environmental degradation. A strong commitment to produce recyclable products made from sustainable resources where possible has been and will be our future policy.



Laboratory Accreditation (ISO/IEC 17025)

Cortec® Laboratories, Inc. is the first lab in our industry that has received ISO/IEC 17025 Certification, which ensures quality in recording and reporting data, as well as calibrating equipment within the laboratory.



LIMITED WARRANTY

All statements, technical information and recommendations contained herein are based on tests Cortec® Corporation believes to be reliable, but the accuracy or completeness thereof is not guaranteed.

Cortec® Corporation warrants Cortec® products will be free from defects when shipped to customer. Cortec® Corporation's obligation under this warranty shall be limited to replacement of product that proves to be defective. To obtain replacement product under this warranty, the customer must notify Cortec® Corporation of the claimed defect within six months after shipment of product to customer. All freight charges for replacement product shall be paid by customer.

Cortec® Corporation shall have no liability for any injury, loss or damage arising out of the use of or the inability to use the products.

BEFORE USING, USER SHALL DETERMINE THE SUITABILITY OF THE PRODUCT FOR ITS INTENDED USE, AND USER ASSUMES ALL RISK AND LIABILITY WHATSOEVER IN CONNECTION THERE WITH. No representation or recommendation not contained herein shall have any force or effect unless in a written document signed by an officer of Cortec® Corporation.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESS, IMPLIED OR STATUTORY, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE. IN NO CASE SHALL CORTEC® CORPORATION BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.



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