



MIGRATING CORROSION INHIBITORS
FROM GREY TO GREEN



Three New DOT Approvals!

We are excited to announce the most recent approvals of MCI®-2005 NS corrosion inhibiting admixture for use by MaineDOT, MassDOT, and PennDOT! This is powerful news to share with engineers in Pennsylvania, Maine, and Massachusetts who can now specify an industry leading admixture in their concrete design mixes for new construction and repair of roads, bridges, and other public transportation infrastructure. MCI®-2005 NS is well-positioned to help DOTs enhance the durability and cost-effectiveness of their infrastructure investments.

DOT approvals not only expand the potential reach of where MCI® can be used for transportation infrastructure; they also lend credibility for use in projects that do not require DOT approval

(e.g., parking garages). Here is a list of MCI® Technology/admixtures that have been approved in a variety of states and provinces over the years:

- British Columbia (MCI®-2005, MCI®-2006)
- California (MCI®-2005 NS)
- Colorado (MCI®-2005 NS)
- Idaho (MCI®-2000, MCI®-2005, MCI®-2020)
- Iowa (MCI®-2005 NS)
- Hawaii (MCI®-2005 NS – approved product in specific mix designs in bridge decks for more than 10 years)
- Kentucky (MCI®-2000, MCI®-2005, MCI®-2005 NS)
- **Maine (MCI®-2005 NS) – New approval!**
- **Massachusetts (MCI®-2005 NS) – New approval!**
- Minnesota (MCI®-2005 AL, MCI®-2005 NS)
- Nebraska (MCI®-2020)
- Ohio (MCI®-2005, MCI®-2005 NS)
- Ontario (MCI®-2000, MCI®-2005 NS, MCI®-2005 AL)
- **Pennsylvania (MCI®-2005 NS) – New approval!**
- Quebec (MCI®-2000)
- South Carolina (MCI®-2000, MCI®-2005, MCI®-2005 NS, MCI®-2006 NS)



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Earn Continuing Education Credits with New AIA Certification!

Did you know you can now earn continuing education credits by taking courses on MCI® Technology? This is thanks to Cortec's recent approval as a "passport" level continuing education system provider (CES) with the American Institute of Architects (AIA)!

Cortec® has always been eager to provide education services to construction professionals on the role of corrosion inhibitors to improve the durability of concrete and steel structures. These presentations include "Lunch and Learns," individual meetings, virtual seminars, industry events and trade shows, and more. With our new AIA certification, these in-person or online learning opportunities will be even more valuable.

Currently registered Cortec® MCI® courses offer participants elective learning units and Health, Safety, and Welfare (HSW) learning units. The courses primarily discuss the corrosion challenges in construction and the role of corrosion inhibitors

in mitigating these problems. The following topics are among the offered courses:

- How corrosion happens in concrete
- Service life modeling to predict the serviceability of a concrete structure
- An introduction to corrosion inhibitors including their types, mechanisms, applications, and limitations
- Testing and verification of corrosion inhibitor performance
- Global case histories where corrosion inhibitors have been used successfully

Registered courses are being offered to all construction professionals and can be requested on the Cortec® MCI® website at this link: <https://www.cortecmci.com/aia-ces-continuing-education-programs/>. Apply today!

Join Us in Welcoming Kevin Quan to Our East Coast Position!

We are happy to welcome Kevin Quan as our new MCI® Regional Sales Manager to support contractors, engineers, and MCI® users on the U.S. East Coast! Kevin has an intriguing background that uniquely positions him to understand and meet client needs both from a technical and business perspective. Starting with a B.S. in Mechanical Engineering, Kevin went on to earn an Executive MBA and spent 20 years in sales and marketing for the aviation, construction, chemical, and nuclear industries.

Of particular interest are Kevin's 15 years working in aviation construction for a designer and manufacturer of a crushable concrete aircraft arresting system. While Kevin's main goal now is to make concrete last as long as possible, his aim at that time was to provide airports around the world with a material intentionally engineered to crush under a specific load in order to safely stop planes from overshooting the end of a runway. The approaches are different, but the basic underlying purpose is the same: to save what is most valuable.

"I like being associated with unique and game-changing technologies," said Kevin. "Cortec® is a leader in corrosion technology with great products that can add value to our customers. It is exciting to be able to introduce them to products that can double the life expectancy of a structure. I also like the safety aspect of our products – it could be life-saving as well as a way to avoid costly future repair work."

Contact Kevin today to talk more about concrete durability!

Kevin Quan, MCI® Regional Sales Manager (East Coast)

Email: kquan@cortecvci.com

Mobile: (445) 400-5163



Fundraising for a 'Concrete' Cause!



This summer's MCI® work included some fun out on the golf course raising money for a good cause! The ICRI (International Concrete Repair Institute) Minnesota Chapter Annual Golf Tournament at Bunker Hills Golf Course took place July 20th as a way to raise funds for the ICRI scholarship, which goes to a student taking courses related to concrete repair, whether in engineering or a related trade.

Cortec's foursome included Jessi Meyer (VP of Sales) Lisa Marston (Technical Service Engineer) and a ready-mix supplier client from AVR. Jon Connealy (Regional Sales Manager – MCI® Central) worked the hole sponsored by Cortec® and gave away small prizes for playing golf Skee-ball on the side. Cortec® also sponsored one of the evening's prize drawings won by MN ICRI member Terry Babcock.

Cortec® has been a proud supporter of ICRI for over 20 years and was happy to promote this go-to source of concrete repair information in a day when concern for proper building maintenance is on the rise!

Learn more about ICRI Minnesota here: https://www.icri.org/page/MIN_chapter



Equip Yourself to Talk with Engineers and Contractors

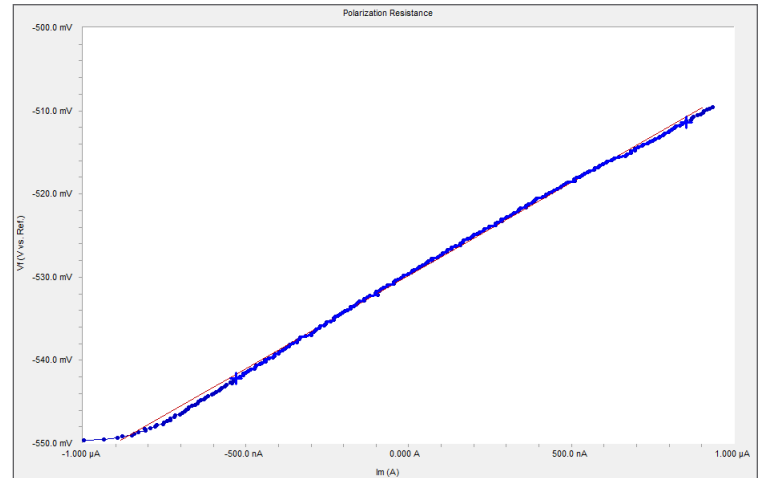
Lifelong learning is a great way to stay fresh on your topic of interest. When it comes to MCI® and the construction industry, there is always plenty to learn or brush up on. To this effect, we have recently published several practical and informative pieces on MCI® topics relevant to MCI® and construction professionals looking for corrosion inhibiting strategies, advice, and resources. See an overview and link to each topic below.

Admixture Testing

As engineers look for ways to design structures that will last over a century before corrosion-related repairs, technologies to inhibit corrosion are more critical than ever. Cortec® Laboratories can assist stakeholders with the all-important screening process by performing accredited ASTM G180 testing. This is one of the corrosion inhibition test measurement options under ASTM C1582, *Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete*.

ASTM G180 testing can be used

- To screen new chemistry formulations as potential corrosion inhibitor admixtures
- To find out if a product qualifies as a corrosion inhibiting admixture in the United States
- To perform standard quality assurance testing
- To do audits like the one recently performed by Cortec® Laboratories on MCI®-2005 for Cortec® Middle East and Dubai Municipality



ASTM G180 Linear Polarization Curve for MCI®-2005

Whatever the case, Cortec® Laboratories can provide the needed testing through its independent ISO 17025 accreditation to perform ASTM G180.

Learn more about ASTM G180 testing through Cortec® Laboratories here: <https://www.cortecmci.com/cortec-laboratories-offers-accredited-astm-g180-testing-for-corrosion-inhibiting-admixtures/>

Comparing Admixtures

Do you ever need an easy way to see how MCI® admixtures compare to the competition? This chart provides an overview of how MCI®-2005 and MCI®-2005 NS line up against competitor calcium nitrite and amine alcohol admixtures. Click here for a more detailed comparison: <https://www.cortecmci.com/how-do-mci-2005-2005-ns-admixtures-compare-to-the-competition/>

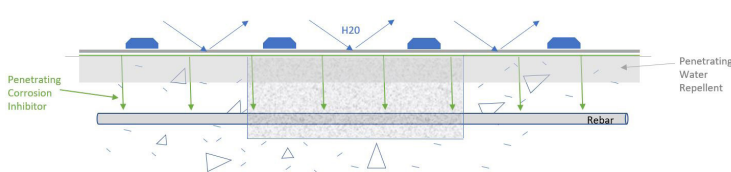
MCI® vs. Competitor Admixtures			
Feature	MCI®-2005/MCI®-2005 NS	Competitors	
		Calcium Nitrite	Amine Alcohol
Set Acceleration	No	Typically Yes	No
Meet ASTM C1582	Yes	Yes	No
Dosage Rates	1-1.5 pt/yd³ (0.6-1 L/m³)	1-6 gal/yd³ [5-30 L/m³]	
Noticeable Impact on Physical Properties	No (except for delayed set time of MCI®-2005)	Yes (may affect fresh or hardened properties, or both)	
Certified to Meet NSF Standard 61	Yes	No	
Contain Renewable Resources	Yes	No	
Increase Shrinkage	No	Yes	No

Selecting the Right Surface Applied Corrosion Inhibitors

When it comes to selecting Surface Applied Corrosion Inhibitors (SACIs) for concrete repair and maintenance, it is important for engineers to know how and why to compare “apples to apples” instead of “apples to oranges.” Otherwise, they may double up on water repellency while overlooking active corrosion inhibitor penetration.

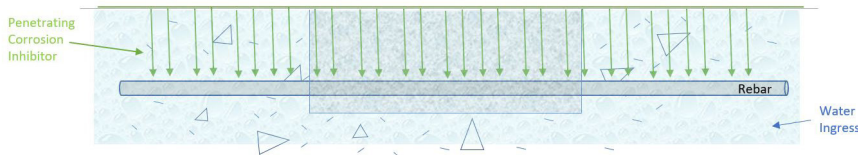
SACIs as defined by ICRI Technical Guideline No. 510.2-2019, “Guideline for Use of Penetrating Surface Applied Corrosion Inhibitors for Corrosion Mitigation of Reinforced Concrete Structures,” are liquids that penetrate concrete to the depth of embedded reinforcement and actively mitigate corrosion on the steel surface. Surface applied products that contain only water repellents do not qualify. They penetrate only millimeters, while SACIs must penetrate inches. Specifying a water-repellent only instead of an SACI would be confusing “apples with oranges.”

Water Repellent with Corrosion Inhibitor Applied to Concrete Surface



Blue dots and arrows represent water-/chloride-/contaminant-repelling features of this two-in-one product. Green arrows represent corrosion inhibitors available to reach the steel at only one-third to one-half the concentration offered by a pure corrosion inhibitor product.

Pure Corrosion Inhibitor Applied to Concrete Surface



In the pure corrosion inhibitor model, there is no water-repellent feature. However, the product has two to three times the concentration of corrosion inhibitor available to reach the steel.

Among products that qualify as SACIs, the amount of corrosion inhibitor is generally highest in “pure” SACI products, and lower in water-repellent-based SACIs (but these materials have the added water repellency feature that allows them to be used as a two-in-one material). Engineers should be aware of the differences so they can specify the best product based on the parameters of the job. This is properly specifying “apples to apples.”

One scenario where it is important to know the difference between “apples and oranges” is in parking structures and bridge repairs that include the application of a traffic deck membrane or other impermeable coating. In this case, it would be ideal to first apply a “pure” SACI with a higher concentration of corrosion inhibitors beneath the membrane instead of doubling up on water repellency with a lower concentration of active corrosion inhibitors by using a water-repellent-based SACI. However, where a topcoat is not being used, the specifier might prefer to recommend water repellent-based SACI as a

two-in-one solution. By knowing the difference between the technologies, the specifier will be equipped to compare “apples to apples” (i.e., “pure” inhibitors to “pure” inhibitors; water-repellent SACIs to water repellent SACIs) in each situation.

Read more about distinguishing and selecting these technologies here: <https://www.cortecmci.com/surface-applied-corrosion-inhibitors-sacis-comparing-apples-to-apples-vs-apples-to-oranges/>

Robust Corrosion Protection at the Depth of Steel Reinforcement

Many excellent technologies delay and mitigate the effects of corrosion on embedded reinforcement, but there are fewer options when corrosion takes place deep inside concrete. Is such difficult-to-access corrosion beyond the reach of existing treatments?

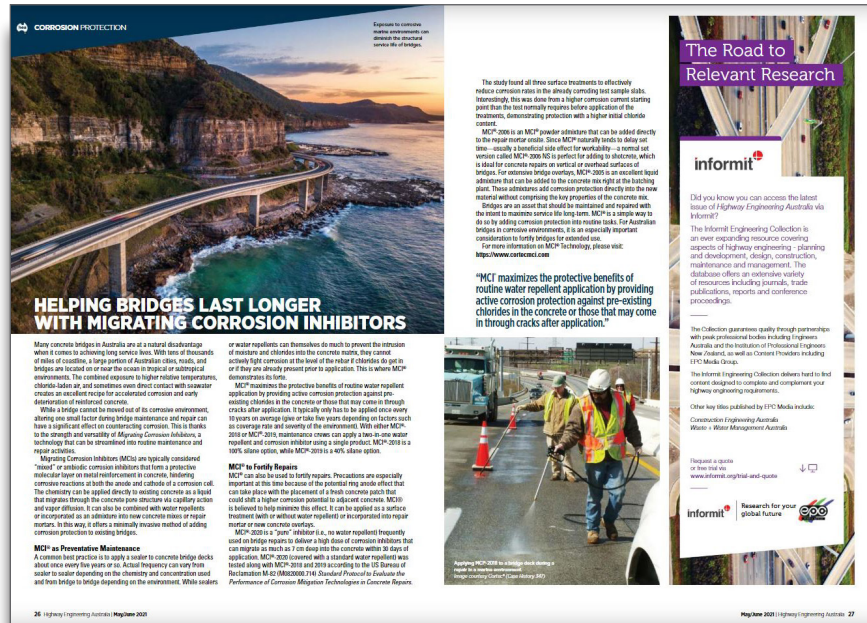
The answer is a resounding “no!” with MCI®-2020 Gel, an injectable corrosion inhibitor which provides a robust dose of corrosion protection directly at or near the depth of steel reinforcement in concrete. The technology has many advantages:

- **Targeted application:** MCI®-2020 Gel can be applied at customizable depths
- **Minimally invasive:** Injection holes can often be drilled smaller than for comparable products
- **Economical to install and maintain:** Holes can be capped for easy reapplication or sealed with repair mortar as desired
- **Attractive safety benefits:** MCI®-2020 Gel is non-flammable, non-combustible, and does not contain secondary amines or nitrites (which together can form carcinogenic nitrosamines)

Learn more about MCI®-2020 Gel and its application potential here: <https://www.cortecmci.com/mci-2020-gel-delivers-robust-corrosion-protection-to-the-depth-of-steel-reinforcement/>

New MCI® Articles from This Spring and Summer!

For those of you looking for informative publications to read yourself or share with your colleagues and clients on the topic of concrete durability, these three recent articles offer some great insights and practical guidance on using MCI®!



'Equipping the Concrete Industry with Corrosion-Inhibiting Sealers' *ASI Adhesives & Sealants Industry* June 2021

This article takes a closer look at how MCI® water repellents can be a benefit to new, existing, or repaired concrete structures. It discusses the advantages of two-in-one MCI® water repellents and offers tips on ensuring successful application. Read the article here: <https://www.adhesivesmag.com/articles/98605-equipping-the-concrete-industry-with-corrosion-inhibiting-sealers>

'MCI® Technology Helps Concrete Structures Last Longer in Harsh Coastal Conditions' *Construction Engineering Australia* April/May 2021

The Sydney Opera House, Victoria State Offices, and Queensland's Art Gallery are a few famous Australian concrete structures mentioned in this MCI® article specifically targeted to Australian engineers but applicable to the construction industry around the world. The article discusses the problem posed by corrosion on reinforced concrete structures and how Migrating Corrosion Inhibitors can reduce corrosion when applied as an admixture, a topical surface treatment, or a combination MCI®/water repellent. Click here and scroll to page 28 to read the article: https://www.epcgroup.com/wp-content/uploads/C071_AprMay2021.pdf

'Helping Bridges Last Longer with Migrating Corrosion Inhibitors' *Highway Engineering Australia* May/June 2021

Although this article focuses on the corrosive challenges of maintaining bridges in the Australian coastal area, it includes technologies and strategies useful for any area around the world where concrete bridges need an added boost of corrosion protection. The article focuses in on "MCI® as Preventative Maintenance" and "MCI® to Fortify Repairs." It specifically mentions MCI®-2018 and MCI®-2019 as MCI® enhanced water repellents, MCI®-2020 as a "pure" inhibitor surface treatment, and MCI®-2006 NS and MCI®-2005 as corrosion inhibiting admixtures for concrete repairs. Read the article here: https://issuu.com/epcmediagroup/docs/h525_mayjun2021/28

Restoration of Toledo-Lucas County Port Authority Parking Garage

A parking ramp in Toledo, Ohio, required patching and repair work because of reinforcement corrosion, concrete delamination, and spalling on slabs exposed to an aggressive environment and deicing salts. To mitigate future corrosion, the engineer specified the use of a surface-applied corrosion inhibitor and water repellent and requested a 10-year anti-spall warranty. The repaired concrete was shot-blasted and power-washed before applying MCI®-2018 using a wet-on-wet technique over an area of 130,000 square feet (12,077 m²). Cores were obtained to confirm product application using the Rilem tube test. MCI®-2018 ended up being cost-effective and easy to apply, and the contractor came away feeling satisfied with the product's performance and Cortec's warranty and support.

Read the full case history: https://www.corteccase-histories.com/?s2member_file_download=access-s2member-level1/ch713.pdf



Enhancing Piling Durability of Hotel in Marine Environment

A three-star Hampton hotel operated by Hilton was slated for construction on Al Marjan Island in the UAE. A marine environment with a high water table posed a greater risk of corrosion and early repair for the reinforced concrete piles that would be built to support the structure. The International Engineering Center provided a referral for MCI® based on past projects, and the structural consultant specified MCI®-2005 corrosion inhibiting admixture for use in 7,000 cubic meters (9,156 yd³) of concrete pilings. The admixture received positive initial feedback upon use and will be an important ongoing factor to mitigate corrosion in this severe environment.

Read the full case history: https://www.corteccase-histories.com/?s2member_file_download=access-s2member-level1/ch717.pdf

Corrosion Mitigation in Underground Condo Parking Garage

The first-floor slab of an underground parking garage built in 1954 was experiencing deterioration after years of exposure to deicing salts during harsh winters in Toronto. The corrosive effect was intensified by pooling water and CO₂ vehicle-exhaust emissions. The problem finally reached a point that needed to be addressed in the summer of 2021. The engineer assigned to the job had had previous success slowing down corrosion rates with MCI®-2020 and therefore specified it for application to the entire slab on level T1. After cleaning and mechanical preparation, the contractor applied two coats of MCI®-2020 (followed by a water-proofing membrane system 24 hours later) and was pleased with the ease of application and Cortec's technical support.

Read the full case history: https://www.corteccase-histories.com/?s2member_file_download=access-s2member-level1/ch732.pdf

PT Protection of the Samuel De Champlain Bridge

The new Samuel De Champlain Bridge is a cable stay bridge designed to replace the original Champlain Bridge. With eight vehicle lanes and a central light rail corridor it is the widest cable stay bridge in the world and one of the largest infrastructure projects in North America to date. Designed for a 125-year service life, the bridge incorporates stainless steel and high-performance concrete for durability in a corrosive environment. MCI®-309 was also used for protection of post-tensioning strands from corrosion during the critical periods of installation and inevitable winter grouting delays. MCI®-309 was optimal because it could be easily fogged dry into the ducts and did not need to be flushed prior to grouting. Previous bond testing at the grouting laboratory of Pennsylvania State University also qualified it to be approved for use on the bridge because it would not adversely affect grouting bond with the tendons. The post-tensioning team was very happy with MCI®-309 application on the main bridge structure, and the same project engineer continues to use it on the Réseau Express Métropolitain light rail segment of the project.

Read the full case history: https://www.corteccase-histories.com/?s2member_file_download=access-s2member-level1/ch724.pdf



Jaffa Port Warehouse Conservation

The Jaffa Port warehouse is located in a very corrosive seashore environment that is very challenging to the durability of structural steel and concrete foundations. The conservation project sought to preserve as many of the building's original elements as possible, and some of the original pillars and the previous foundation were saved. However, a new foundation and concrete floor also had to be made next to the old one. A performance-related concrete design method was chosen as the best solution due to the exposure level and project conditions under article 5.3.3. of EN-206-1. MCI®-2005 was selected as the corrosion inhibitor for the new floor and foundation. This served as a built-in solution for non-constructive application errors and also performed well as part of a concrete mix that had better workability and less cracking for the contractor.

Read the full case history: https://www.corteccase-histories.com/?s2member_file_download=access-s2member-level1/ch730.pdf



Image Courtesy of Government Press Office.



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Case Histories

Mercantile Parking Garage: Building for 100-Year Service Life

The Mercantile is a new mixed-use redevelopment complex currently being built in the heart of downtown Omaha, Nebraska, on the previous site of ConAgra world headquarters. A four-level post-tension (PT) parking garage is part of the complex. It is a poster child of smart engineering designed with an estimated 100-year service life before the first corrosion-related repair. Corrosion protection is critical in this climate where winter freeze-thaw cycles result in excessive melting snow and freezing rain that require heavy use of deicing salts. However, a negative recent experience with calcium nitrite corrosion inhibitor (CNI) that accelerated concrete set time and made concrete difficult to finish prompted the contractor to find an alternative admixture for this job.

MCI®-2005 NS was selected, but the contractor was still extremely concerned about completing the first pour on a day when the heat index reached 100 °F (38 °C) at 9:30 in the morning, fearing that it would accelerate concrete set time. His MCI® regional sales manager reassured him that they could go ahead and treat the mix like they would regular 6500 PSI concrete on a 100 °F (38 °C) day. They did so and soon noticed how much easier the mix was to place and consolidate than CNI. Even an unexpected interruption did not keep them from achieving a good finish with an 8 inch (20 cm) slump and significantly more surface bleed water than ever experienced with CNI.

The contractor said it was the best PT mix he had ever put down, and he would never want to use the other product again. He predicted other ready-mix suppliers would want to make the switch when they saw how well it worked. This came true in less than a week when all bids for a new parking garage in the area included MCI®-2005 NS as their corrosion inhibiting admixture.

Read the full case history: https://www.corteccase-histories.com/?s2member_file_download=access-s2member-level1/ch734.pdf



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UPCOMING EVENTS

2021 ICRI FALL CONVENTION

October 11th-13th, 2021

Theme: *Evaluation and Forensics—"Despair to Repair"*

Marriott Minneapolis City Center | Minneapolis, Minnesota

Sign up: <https://www.icri.org/event/2021-ICRI-Fall>