

# CONCRETE DURABILITY Newsletter

Featuring MCI migratory corrosion inhibitors and GalvaCorr advanced cathodic protection technologies

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## GalvaCorr Case History

By Marlin Hanson

A second trial application of the new GalvaCorr product was completed this fall in cooperation with the City of St. Paul's Bridge Department. This system will provide galvanic protection to embedded reinforcement on the Maryland Avenue Bridge near I-35E in St. Paul, Minnesota.

Electrical connections were made to the reinforcement steel and millivolt potential readings were taken. It was found that a moderate to high level of rebar corrosion existed. The underside surface of the bridge was cleaned prior to application of the coating. The wiring grid contained within the completed coating was connected to embedded reinforcement through a connection box, allowing for future testing. Within three days the

connected system had reached the NACE standard of 100 millivolts of polarization. After 30 days, the trial application had reached 198 millivolts of polarization. In April of 2004 Cortec will be conducting a depolarization test to further evaluate this installation.

Cortec GalvaCorr is not only easier to apply, it is also three times **less expensive** than 3M's Zinc Hydrogel Anode System!

## New Product Highlights

### MCI 2311 Repair Mortar

MCI 2311 repair mortar is a new addition to Cortec's repair line. MCI 2311 is a single component, full-depth repair mortar designed for horizontal repairs of 1/2" to 4" (1.25 cm to 10 cm) in depth. Unlike conventional repair mortars, MCI 2311 has low shrinkage and provides a stable bond to the substrate that prevents

perimeter cracking. MCI 2311 has an early recoat time allowing coatings to be applied 72 hours after placement of the MCI 2311.

### Anti-Graffiti Architectural Coating

By Mike Prenosil

Cortec has recently developed an anti-graffiti coating for concrete. This two-component, solvent based urethane coating is designed for easy removal of ink or paint graffiti applied to concrete. Most solvents can be used to remove this graffiti. In addition, Cortec's VpCI 432, VpCI 433 and Eco Spray Graffiti Remover 433 can be utilized when solvent resistant graffiti is encountered. Anti-Graffiti Architectural Coating has excellent adhesion properties when applied over MCI 2020 M.

Cortec Anti-Graffiti Architectural Coating can also be applied to solvent based coatings on steel.

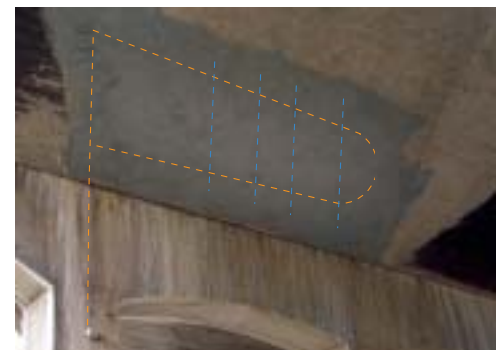
# GalvaCorr



Underside application by the St. Paul traffic department on the 30 year old bridge on Maryland Ave. The GalvaCorr was hand applied with rollers. The project included sandblasting, excavating to connect the rebar and to access the condition of the rebars, applying the coating wires and then the coating.



This is the finished coating and wiring system. A small junction box is visible above the ladder. This box is used to take the system readings. A St. Paul Department observation was: "There is nothing to vandalize or steal."



Here, the almost invisible current collecting wires of the coating are highlighted. Part of the insulated current return wire to the rebars is visible over the pier arch.



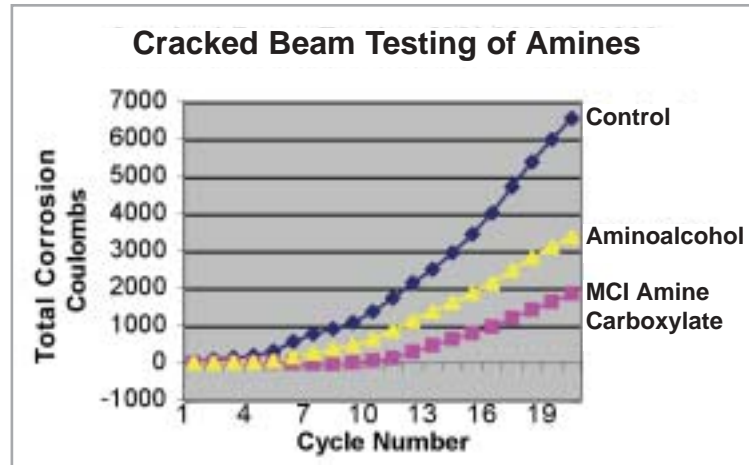
## Competition Puts up a Fight

Fall brings changing leaves, cooler weather and competitive football games. Of course Jessi knows that the Packers are a much better football team than the Vikings, but it doesn't stop Cliff from trying to prove her wrong. Recently, Cortec's competition, SIKA, has changed their Ferrogard data sheets making them appear more similar to our MCI products. Since this is confusing to both our distributors and end users, we have some notes to aid you in deciphering these changes.

### MCI 2020 vs. Ferrogard 903

1) Ferrogard 903 is based on Amino-alcohol technology (similar to our older, MCI 2000 series), while MCI 2020 is based on amine carboxylate technology (see diagram for corrosion protection comparison). MCI 2020 amine carboxylate technology is better than the amino-alcohol technology in terms of corrosion protection.

2) Amino-alcohols have partial + and partial - charges ( $\delta+$  and  $\delta-$ ) within each molecule that attracts them to the steel, but the overall charge on the molecule is zero, similar to what you have with water molecules. These partial charges



These free ions are attracted to the anodic and cathodic areas of the steel. Because they have an actual charge, their affinity for the steel is stronger than the affinity of partially charged pieces, which is why they are able to provide a better reduction in corro-

are attracted to both anodes and cathodes, which is how they can help reduce the amount of corrosion. MCI 2020 is a blend of organic inhibitors. Some of this blend has molecules with similar partial + and partial - charges. But, a majority of this blend consists of an amine carboxylate that reacts with the concrete as it migrates through.

sion rates than the amino-alcohol once they reach the steel.

What happens is that the amine carboxylate reacts, leaving an insoluble salt in the pore, effectively blocking some of the pores and making future ingress of chloride and other contaminants more tortuous. At the same time, the free  $N^+$  and  $COO^-$  charged ions that are a result of this reaction, migrate towards the embedded reinforcement to provide protection.

3) Ferrogard 903 requires at least two coats, in many cases more. The total dosage rate is said to be 100 ft<sup>2</sup>/gallon (2.45 m<sup>2</sup>/liter). This has changed from past data which stated that the coverage rate was 100 ft<sup>2</sup>/gallon (2.45 m<sup>2</sup>/liter) per coat! MCI 2020 only requires one coat at 150 ft<sup>2</sup>/gallon (3.86 m<sup>2</sup>/liter) for most applications. In cases of dense concrete or vertical structures (when you aren't using MCI 2020 V/O), you would apply two coats of MCI 2020 at a rate of 300 ft<sup>2</sup>/gallon (7.72 m<sup>2</sup>/liter) for a total dosage rate of 150 ft<sup>2</sup>/gallon (3.86 m<sup>2</sup>/liter). In any case, we have a larger coverage rate, with fewer coats required,

### Examples of Reports Showing the Migration of MCI Inhibitors in Concrete

Analysis of Diffusion Rate of Migrating Corrosion Inhibitor MCI 2000 in Concrete Using Radioactive Isotope Tagging Techniques	Alex Eydelnant, A.B. Ostrovski, PhD, and A.M. Demidov	9/1/1993	Institute of Construction Materials, Kurachatov Institute of Nuclear Physics; Moscow, Russia
Corrosion Protection of Steel Rebar in Concrete with Optimal Application of Migrating Corrosion Inhibitors, MCI 2022	Behzad Bavarian, PhD, Lisa Reiner	3/1/2003	University of California-Northridge
MCI Modified Fairing Coat Site Evaluation	Paul Lambert	10/1/2002	Sheffield Hallam University

### Examples of Reports Showing Effectiveness of MCI Inhibitors in Concrete

Cracked-Beam Corrosion Tests of Concrete Treated With MCI 2000 and MCI 2020 Corrosion Inhibitors	Matthew Sherman, Paul Krauss	1/1/1995	Wiss, Janney, Elster Associates, Inc.
Report of Concrete Corrosion Inhibitor Effectiveness	Daniel Vruno, PE, Richard Stehly, PE	1/1/1995	American Engineering and Testing, Inc.
Long Term Corrosion Testing of MCI 2020 (November 1994-April 1999)	Dr. Masaru Nagayama, Mr. Kazuyuki Shimozawa	4/1/1999	General Building Research Corporation of Japan

meaning a lower cost per square foot, and much less in labor costs for the contractors and end users.

4) The Ferrogard 903 data sheet states that you must protect glass, wood, brick, galvanized steel, and exposed aluminum during the application of the product. This is not required when you use MCI 2020, which would also lead to a savings in labor costs for the customer.

5) The Ferrogard 903 data sheet states that a minimum of one hour wait time between coats is needed; however, it also says that the concrete should be as dry as possible for best ingress of the product. Our data sheet says that one should wait several hours (7.5-8) between coats if you are applying two coats, however, this time frame can be shortened provided the concrete substrate is adsorbing the MCI 2020 and isn't saturated, allowing the product to pool and run down the surface. Also, remember that we rarely require two coats, so this normally isn't an issue. Of course the drier the concrete is, the faster the ingress of the material, but it isn't necessary to have extremely dry concrete when applying the MCI 2020 product.

6) MCI 2020 can be used under similar circumstances for chloride levels as the Ferrogard 903. (6 lbs/yd<sup>3</sup> of chloride at the reinforcing steel, up to 10 lbs/yd<sup>3</sup> when consulting with Cortec Technical Service for application information).

7) It is important to keep in mind that the migration rate of amino-alcohols and amine carboxylates depends on several factors, including the porosity of the concrete, temperature, and moisture conditions. In cases of poorer concrete, the MCI and Ferrogard products can migrate quickly, in the case of better quality concrete, migration rates take longer. Similarly to how quickly chlorides migrate in concrete...they go faster in poor quality concrete, and slower in bet-

ter quality concrete. The rate of migration of amino-alcohols and amine carboxylates is similar.

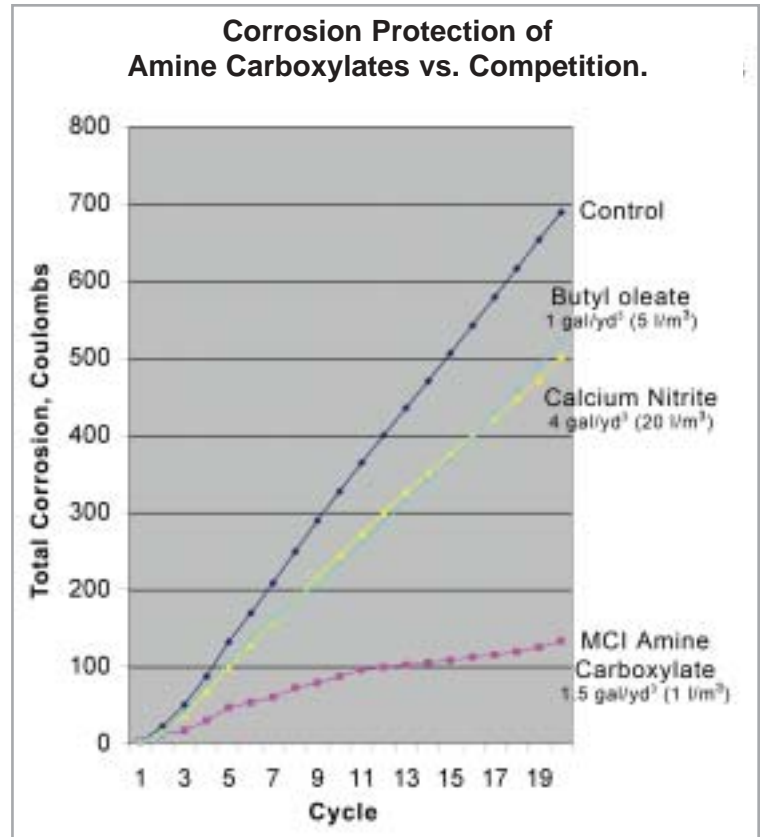
### MCI 2005 NS vs. Ferrogard 901

1) Again, Ferrogard 901 is based on amino-alcohols, and MCI 2005 NS is based on Amine Carboxylates. Please see #1 and #2 under MCI 2020 vs. Ferrogard 903 for further explanation.

2) MCI 2005 NS is dosed at 1.5 pints per cubic yard. Ferrogard 901 is dosed at a rate of two to three gallons per cubic yard. MUCH HIGHER! This is why you always want to compare cost per cubic yard (or cubic meter) rather than cost per gallon. Adding the Ferrogard 903 also requires that the mix water added to the concrete be adjusted, whereas no adjustments are necessary with the MCI 2005 NS product.

3) See diagram Corrosion Protection of Amine Carboxylates vs. Competition.

4) Finally, if you wanted a direct competitor to the Ferrogard 901, you could revert to our MCI 2000 product. However, it also has advantages over the Ferrogard 901. MCI 2000 is only dosed at a rate of 1 pint per cubic yard versus two to three gallons per cubic yard, so again, compare cost based on dosage, not cost per gallon. There is also no need for adjustments to the mix water with the MCI 2000 as there is with the Ferrogard 901.



### MCI 2020 in New Test

The Port Authority of New York and New Jersey has incorporated the MCI 2020 along with several competitor products into a test on a parking ramp at La Guardia Airport in New York. A total of five products will be tested and evaluated by the Port Authority for their effectiveness.

Surface preparation for the test areas included shot blasting of a 500 ft<sup>2</sup> (46 m<sup>2</sup>) test area for each product involved. MCI 2020 was applied to its test site in a one coat application at 150 ft<sup>2</sup>/gallon. The pictures shown are of MCI 2020's application to the test site, taken on Monday, November 24, 2003.

The post application testing will involve linear polarization and half cell analysis 1 month after the application, and every four months thereafter for the first year. During testing, ambient temperature, relative humidity, concrete temperature, and the amount of precipitation during



MCI 2020 has been included in a test on a parking ramp at La Guardia Airport in New York.

the preceding three days shall be recorded. The areas to be tested will be thoroughly wetted the day of testing. An evaluation will be made after one year to determine future testing. Surface frictional properties using an British Pendulum Tester (ASTM: E303) will also be performed after the migrating corrosion inhibitor has fully cured.

## Report Card for America's Infrastructure

The American Society of Civil Engineers (ASCE) has updated their 2001 report card for America's infrastructure. The condition of our nation's roads, bridges, drinking water systems and other public works have shown little improvement since they were graded in 2001, with some areas sliding toward failing grades. ASCE estimates a need of \$1.6 trillion dollars investment to bring conditions to acceptable levels, up from \$1.3 trillion dollars in 2001.

Problems that contribute to the overburdened infrastructure remain, including population growth, voter opposition to infrastructure projects, and the continuing deterioration of an aging system. In addition, threats of possible terrorist attacks have diverted maintenance and growth funding to implement infrastructure security measures. This type of data can only help support the use of corro-



The areas to be tested are thoroughly wetted the day of testing. An evaluation will be made after one year to determine future testing.

sion inhibitors, as they are able to extend the useful working life of our infrastructure by mitigating corrosion.

For more information, including local infrastructure conditions and state infrastructure statistics, visit: <http://www.asce.org/reportcard>.

PROGRESS REPORT	
America's Infrastructure 2003	
Roads	D+ ↓
Bridges	C ↔
Transit	C- ↓
Aviation	D ↔
Schools	D- ↔
Drinking Water	D ↓
Wastewater	D ↓
Dams	D ↓
Solid Waste	C+ ↔
Hazardous Waste	D+ ↔
Navigatable Waterways	D+ ↓
Energy	D+ ↓
<b>America's Infrastructure GPA</b>	<b>D+</b>
<b>Total Investment Needs</b> (estimated five-year need)	<b>\$1.6 Trillion</b>

## MCI Protects Carbonation Induced Corrosion!!

A new study done by Dr. Xu Yongmo and She Hailong of China Building Materials Academy shows the effectiveness of MCI admixtures from preventing corrosion in carbonated concrete. This study showed that both MCI and sodium nitrite were effective in mitigating corrosion in carbonated structures not exposed to chlorides. Only the MCI inhibitor was effective in mitigating corrosion in carbonated structures under chloride attack. Please see the enclosed paper that will be published in the January 2004 issue of NACE Materials Performance magazine for the full details. You will also find Cortec's Pentagon Case History enclosed. MCI 2020 was specifically chosen for use at the Pentagon because it is able to mitigate corrosion induced by carbonation.

**Don't Miss**  
the  
**World of Concrete!**  
Orlando, Florida • February 17-20  
Cortec Booth 7772

Jessi Jackson Meyer, Technical Sales Manager for MCI, will be available Monday 16- Friday 20 for meetings.

Visit our website for more information on Migratory Corrosion Inhibitors™  
**CortecMCI.com**



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