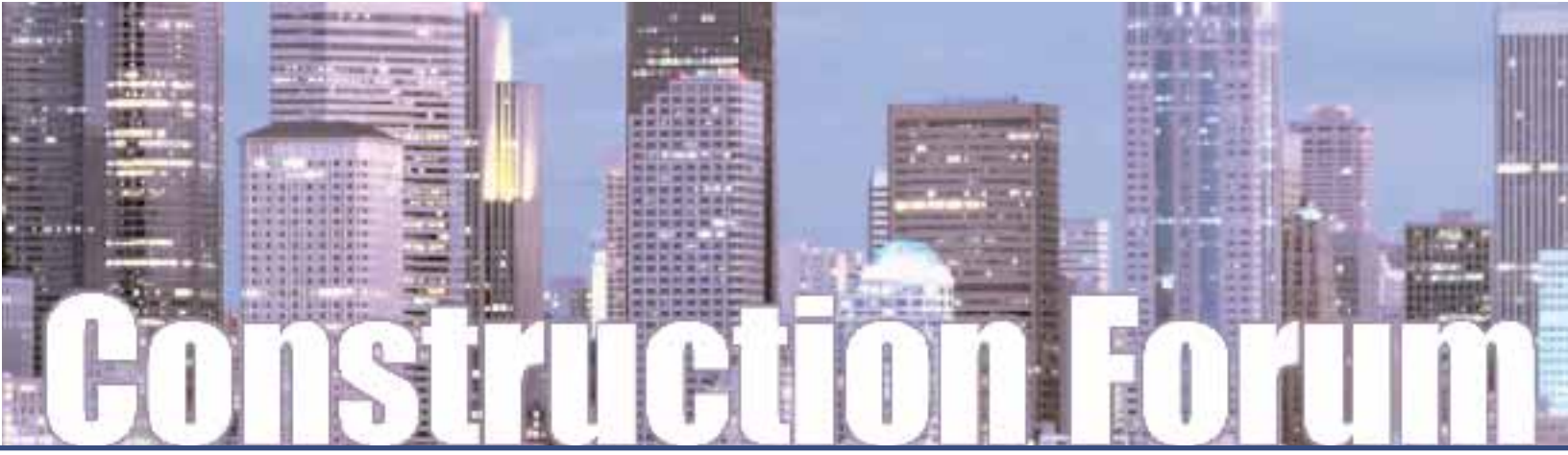

Published by the Cortec® Corporation *February 2002*

New Product Releases

MCI® Repair Grout Stops Rust On Reinforcing Bar

MCI® 2023 Passivating Grout forms a cement slurry that cures to a water-repellent barrier on steel reinforcing bars used in concrete structures. The MCI® Grout seals out moisture, water, and water-solubilized salts. It stops the attack of deicing salts, saltwater, and carbonation which readily cause concrete deterioration. During the repair process, the grout applies easily to provide years of long-term protection.

Effective for all types of steel rebar, the MCI® 2023 Passivating Grout works very effectively for reinforcing steel that is close to the surface and has only a thin layer of concrete. This surface type of rebar is the most susceptible to fast, aggressive attack from corrosive elements of solubilized salts and carbonation. Corrosive agents quickly penetrate through the thin top layer of concrete and immediately start to rust any open area of steel rebar. The rust easily causes the concrete to crack, enabling even faster transfer of corrosive agents, and then finally concrete spalling, flaking, and exposure of the rebar itself to the elements.

The strength and durability of MCI® 2023 Passivating Grout come from a two component system that is mixed together on-site. One part is a powder formulation consisting of hydraulic binders with complexing and osmotic agents that provide a high degree of passivation to the metal. The second component is a water-based emulsion of organic polymers. When mixed, they form a slurry with excellent adhesion to rebar and other surrounding substrates. The slurry is easily applied with a brush, multiple coats can be applied as necessary. After the rebar has been coated with the repair grout, mortar can then be applied with conventional techniques.

MCI® Repair Grout

The cured grout forms a resilient barrier against water and corrosive agents. Further, it incorporates Cortec® MCI® technology. This patented chemistry provides self-replenishing corrosion inhibitors that protect the rebar metal surface at the molecular level to block the oxidation and rust process from starting. The MCI® material will migrate through the concrete to other adjacent reinforcing bars to aid in their protection.

New Water-based Architectural Coating Protects Concrete, Copper, Steel, and Aluminum

Cortec® MCI® Architectural Coating introduces optimal outdoor performance in a water-based formulation. The coating provides the type of protection required by structures in harsh outdoor environments and aids in preserving their life and beauty. Cortec® MCI® Architectural

MCI® Architectural Coating

Coating acts as a tough barrier that prevents water penetration, chloride ingress from metropolitan and coastal exposure, and the deteriorating effects of carbonation.

Unlike conventional coatings, Cortec's Architectural Coating has pulled out traditional pigments and metal oxides and replaced them with more effective corrosion inhibitors. Blended with Cortec's patented MCIs, the new coating provides a superior source of corrosion inhibition that protects embedded reinforcement and other metals such as steel, copper, and aluminum. The Cortec® coating uses its special combination of additives to form a composite polymer barrier that significantly prolongs the life of reinforced concrete for new and restored structures. Their unique chemistry protects both the outside concrete surface and the inside metal reinforcement of the structure from aggressive weather and corrosive electrolytes.

The Cortec® coating offers excellent adhesion to concrete and metal surfaces. As a water-based polymer with elastic characteristics, the coating is highly resistant to peeling, bubbling, and cracking. Its offers UV resistance and thermal stability from –40oF to +400oF (-40oC to +204oC).

The coating is available in transparent, standard and custom colors. As a transparent coating, it allows a restored structure to be protected while showing its original surface coloring. For restored and new structures, this transparency allows easy visual inspection of the condition of the surface over time. Where a structure does not require a transparent coating, Cortec's MCI® Architectural Coating is also available in standard and custom pigments.

As a new generation coating that is environmentally friendly, the water-based coating is non-toxic and non-flammable. The coating can be applied by conventional means including spray application.

Concrete Sealer Stops Rust While Repelling Water

A new topical surface treatment based on Cortec® patented MCI® technology seals out water while stopping rust. Cortec® MCI® 2022 is effective for new construction, maintenance repair, and restoration of concrete, brick and masonry. The easy-to-apply liquid comes ready-to-use. No dosages or mixing are required. The operator can spray, roll or squeegee the material onto horizontal and vertical surfaces with conventional application methods.

Part of Cortec's new generation of eco-friendly formulations, MCI® 2022 is environmentally sound. Using water-based chemistry, it offers users a non-toxic, non-flammable and fully biodegradable product without the use of nitrites, phosphates, or solvents. Further, operators do not need special safety suits. After application, no special disposal precautions are required.

MCI® 2022

MCI® 2022 employs the latest chemical technology for increasing the life of concrete structures. After application, it provides a water-repelling seal so effective that it blocks carbonation and chloride ion intrusion while still allowing the treated surface to breath and have natural moisture-vapor transmission. Its patented MCI® chemistry

penetrates deep into the concrete for anodic and cathodic protection of all types metal reinforced structures. Even for the densest concrete, the MCI® will penetrate to protect a variety of metals including carbon steels, galvanized steel and aluminum.

The sealer can be used for all types of reinforced, precast, prestressed, and post-tensioned concrete structures. It is highly resistant to alkaline, salt, and chloride attack from saltwater and de-icing chemicals. This capability makes it especially applicable for marine structures, bridges, parking decks, ramps and garages. Its dual anodic and cathodic protection also inhibits aggressive attack from metropolitan and industrial SO2 atmospheres, acids or other harsh chemicals making it ideal for outdoor surfaces such as concrete piers, pillars, pipe, or utility poles and indoor surfaces such as plant floors.

Wells Fargo Parking Ramp MCI® Case History

Cortec Corporation's MCI 2005 NS is being used in a new parking ramp for Wells Fargo in Minneapolis. The structure is located at 2800 4th Street in Minneapolis. The engineering firm responsible for the design specifications of the ramp is Meyer, Borgmann, and Johnson, with M.A. Mortenson as the general contractor, and Aggregate Industries supplying the concrete.

The post-tensioned structure will require approximately 20,000 cubic yards of concrete, 3750 gallons of MCI 2005 NS and 21, 875 gallons of Enduracon HR Superplasticizer. The concrete is designed to reach 3,000 PSI in 24 hours, and is pumped with an 8-inch slump. This project will continue through March 2002. Please see the new case history enclosed with your newsletter. Watch for a video in April!

MCI Approved by South Carolina DOT!

South Carolina DOT approved MCI 2000 in November 2001. This means that MCI is now approved in Colorado, Kentucky, South Carolina, and Wyoming. Approvals are pending in several other states. We are requesting that all distributors and representatives seek DOT approvals for their specified territories. Contact Jessi Jackson Meyer at extension 185 for any needed assistance/product information.

New Version of LIFE-365

LIFE-365 Version 1.0 has expired. You can obtain copies of the new version, 1.1, from Cortec Corporation.

Market for Corrosion Inhibitors

New information released by the CCIA (Concrete Corrosion Inhibitor Association) revealed that member companies of the CCIA treated 1.75 MM cubic yards of concrete in the year 2000. Early estimates for 2001 final numbers put the total of treated concrete at 1.82 MM cubic yards of concrete treated, a 4% growth between 2000 and 2001. If it is assumed that these companies have 90% of the total market, than the total actual market is 2.0 MM cubic yards of concrete.

If we can further assume that the cost of a treated yard of concrete is $16, then the actual market translates to $32 MM. The estimated market for epoxy coated bars is placed around $100-150 MM. That is based on 0.5 MM tons of epoxy bar being sold annually. This then translates into a total potential market of $182 MM where members of the CCIA have 18-24% of that market.

The Rehabilitation of the Randolph Street Bridge

by Jessica Jackson Meyer

This case study describes the rehabilitation of the Randolph Street Bridge in St. Paul, Minnesota, which underwent repairs after 22 years in service. The westbound lanes were treated with a migrating corrosion inhibitor (MCI), while the eastbound lanes were kept as the control group. In November 2000, researchers revisited the site to see how the westbound lanes fared against the eastbound lanes.

Who Uses Cement?

As reported by the Portland Cement Association, here is the breakdown of cement use for the year 2000:

Streets/highways	32%
Residential buildings	22%
Commercial buildings	19%
Water/waste construction.	9%
Public buildings	8%
Other	6%
Farm construction	4%
Utilities	1%

The reports on the apparent use of portland cement in 2000 are available on PCA's web site: www.portcement.org/mkt <http://www.portcement.org/mkt> .

RESEARCH ON CORTEC PRODUCTS

MIGRATING CORROSION INHIBITING ADMIXTURES FOR REINFORCED CONCRETE

"EFFECTS OF MIGRATING CORROSION INHIBITORS ON REINFORCED LIGHTWEIGHT AND COMMON MORTARS"

2nd International Congress on Studies in Ancient Structures
Istanbul, Turkey, 9-13 July 2001
(Accepted for presentation)

PURPOSE:

The objective of these experiments was to investigate mortar with Corrosion inhibitor as corrosion protection system and evaluate its performance in reference to specimens without any addition of admixtures.

The migrating corrosion effectiveness was assessed in lightweight concrete with Greek pumice stone and in common mortar specimens. The inhibiting behavior of organic amino-based migrating corrosion inhibitors against steel corrosion was evaluated by specimens' immersion into 3.5% w.t. sodium chloride corrosive solution and by exposure to the atmosphere. The corrosion activity and inhibiting efficiencies (IE) were tested by measuring the rebars weight loss, their half-cell potential, carbonation depth and electrochemical measurements of chronicles corrosion rate of rebars in concrete specimens.

Experimental duration: 1 year

Table 1: Type and Composition of specimens

Specimens						
	Composition ratio					
Code Name	Cement	Pumice	Sand	Water	Corrosion Inhibitor (lt/m^3)	Remarks
K-I	1	3	-	1	-	***Category I***: *Immersed in 3.5%w.t NaCl*
KM-I	1	3	-	1	1.24	
S-I	1	-	3	0.6	-	
SM-I	1	-	3	0.6	1.24	
K-II	1	3	-	1	-	***Category II***: *Exposed in Atmosphere*
KM-II	1	3	-	1	1.24	
S-II	1	-	3	0.6	-	
SM-II	1	-	3	0.6	1.24	

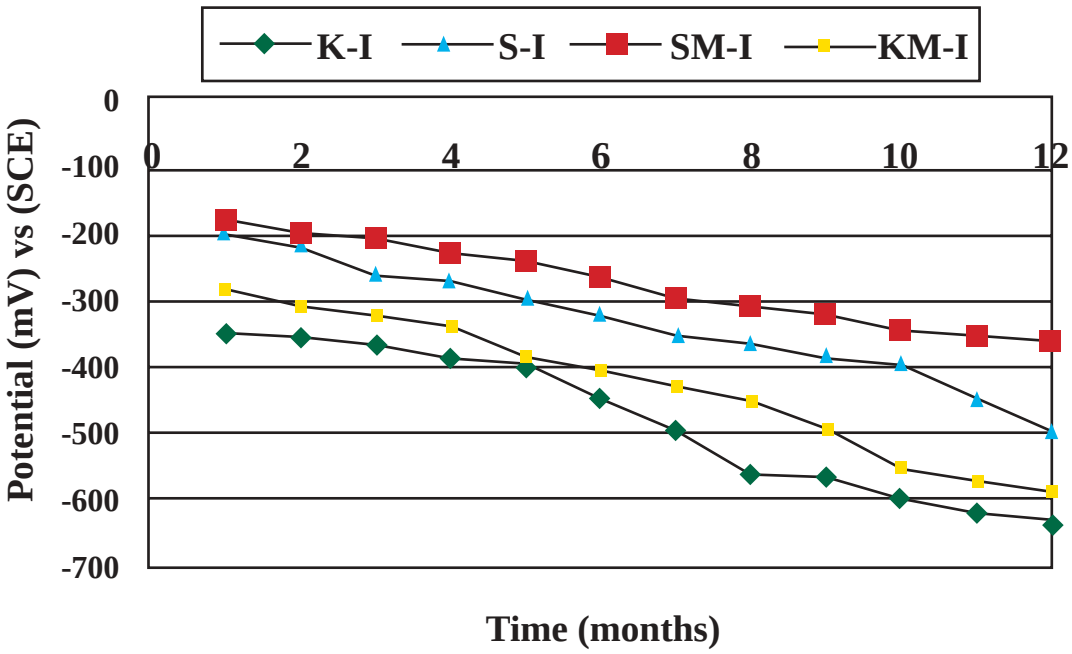

Figure 1:

Half-cell potential measurements vs immersion time

According to the standard test method ASTM C 876, Standard test method for Half Cell Potentials of reinforcing steel in Concrete, the more negative the voltometer reading, the greater the probability of active corrosion. Values less than -350mV, have as a result 90% probability of active corrosion. It is obvious that for all the specimens there is a tendency for the reduction of their potential value from the range of -300mV to -650 mV. These measurements suggest a high probability of an active stage of corrosion throughout the test period.

RESEARCH ON CORTEC PRODUCTS

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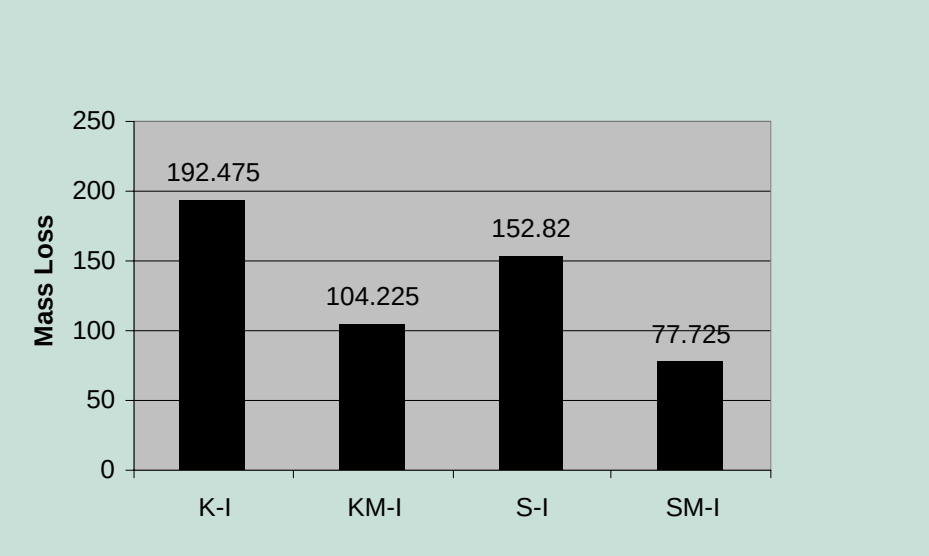


Specimens immersed in 3.5%w.t NaCl

Figure 2:
Mass loss measurements of lightweight and common mortars after 12 months of partially immerse to NaCl 3.5%w.t

The mass loss differences are higher when lightweight mortars are compared to common mortars that contain as aggregate sand. From these results, the improvement of the mortars properties and consequently of the corrosion performance of steel rebars when the amino-based corrosion inhibitor added is evident. The INHIB-M, lowering the steel rebar mass loss after twelve months of exposure by about 45% in lightweight mortar and 50% in common mortar specimens.

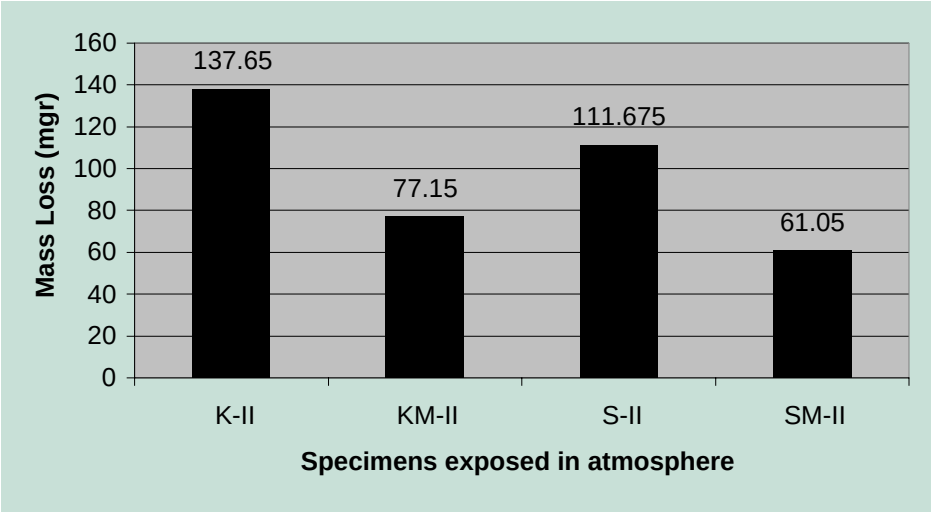
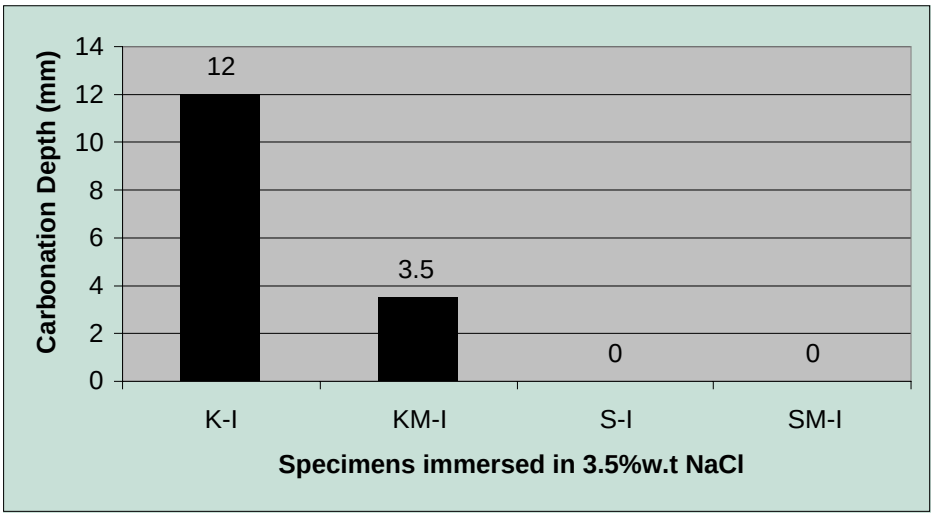


Figure 3:
Mass loss measurements of lightweight and common mortars after 12 Months of exposure to atmosphere

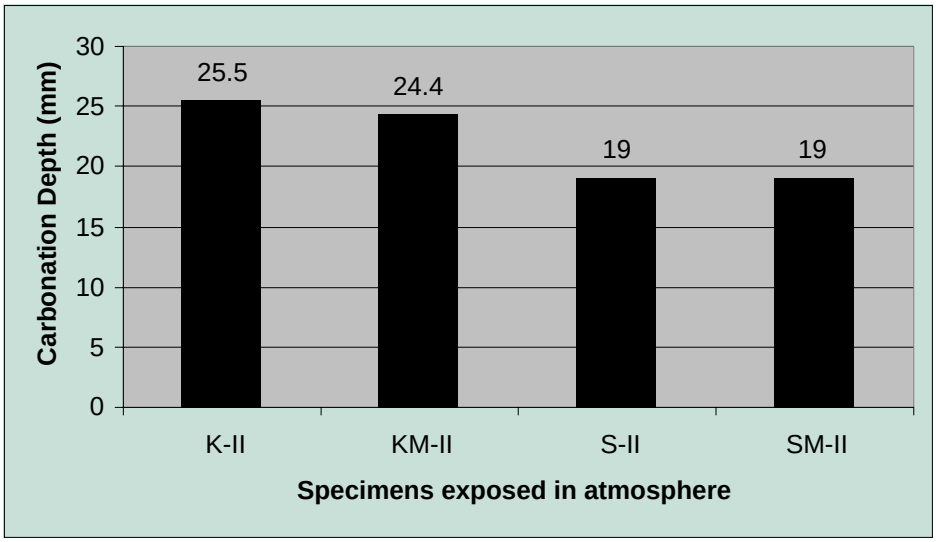
The INHIB-M, lowering the steel rebar mass loss after twelve months of exposure by 44% in lightweight mortar and 45% in common mortar specimens.



Specimens immersed in 3.5%w.t NaCl

Figure 4:
Carbonation depth of lightweight and common mortars after 12 months of partially immerse to NaCl 3.5%w.t

Between mortars with sand and mortars with Greek pumice as an aggregate, it is observed that the specimens, which exhibit carbonation, were the latter mortars. Lightweight specimens without corrosion inhibitor, exhibit 3.5 times higher carbonation depth values than those with corrosion inhibitor. From these results, it seemed that the corrosion inhibitor addition in the lightweight mortars protect steel by a mechanism that seemed to influence to carbon dioxide access.



Specimens exposed in atmosphere

Figure 5:
Carbonation depth of specimens' constructed with lightweight and common mortar after 12 months of exposure to atmosphere.

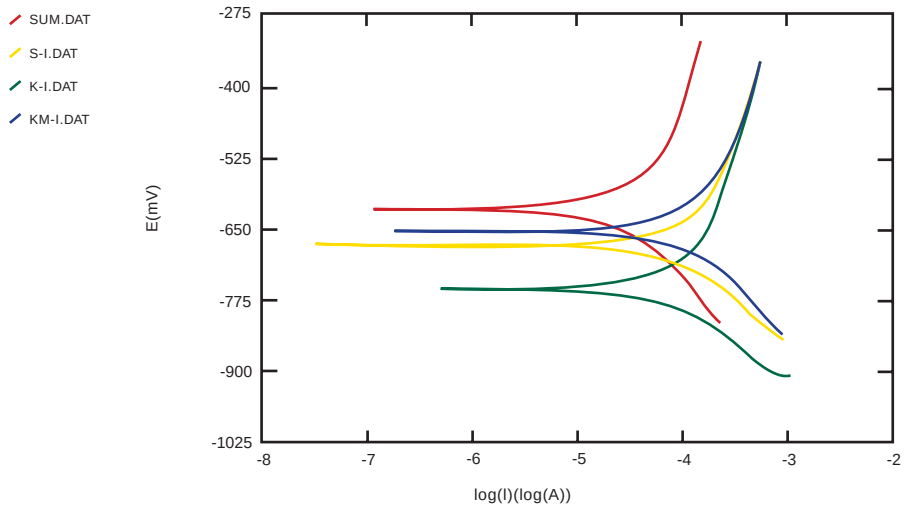


Figure 6:
Tafel plots curves for reinforcing steel in common mortar and lightweight specimens immersed in 3.5%w.t. NaCl

From these results, it seemed that the corrosion inhibitor addition in mortars protect steel by a mechanism that does not seem to influence to carbon dioxide access. The carbonation depth in lightweight mortars is definitely higher than those in mortars with sand as aggregates.

In Tafel plot technique, a potential scan was applied to the specimens starting from E_{corr} and extending to 250mV either in the cathodic or anodic direction. The current measurements in this case were the difference between anodic and cathodic currents. In linear polarization technique, a controlled potential scan was applied to the specimens in a range much smaller than that used in the Tafel plot. It was from E_{corr} -25mV to E_{corr}+25mV. The R_p polarization resistance, which is the slope of the potential current curve at E_{corr} is related to $I_{corr.}$

CONCLUSIONS

The usage of corrosion inhibitors has decreased corrosion both in the specimens that were partially immersed in 3.5%w.t NaCl as well as in those that were exposed in atmospheric conditions exposed for about 45% and 50% respectively.

The results of the electrochemical measurements for calculating the corrosion rate in order to have a first estimation of the corrosion of the mortar specimens that were partially immersed in 3.5%w.t NaCl solution are certified and confirmed by the results of the calculations of the reinforcements mass loss in the mortars for a twelve month corrosion period.

The carbonisation with a high porosity aggregates is by far larger when compared with the one in the specimens that were mortars made with common sand. The corrosion in the lightweight mortars had reached the surface of the reinforcements in about a year's time and in that case, the corrosion inhibitor has decreased the reinforcements corrosion for about 45%. **As a result the conclusions of this study are in line with the confession that the usage of corrosion inhibitors is doubling the lifetime of the constructions.**

MIGRATORY CORROSION INHIBITOR™
(MCI®) PRODUCTS FOR CONCRETE

CASE HISTORY
MCI® 2005 NS

DATE
January 2002

CUSTOMER
Wells Fargo Bank Parking Ramp

PREVENTION
Wells Fargo bank decided to invest in the longterm protection of a new parking ramp located at 2800 4th street Minneapolis MN. Meyer, Borgman, and Johnson the engineering firm designed the ramp. M.A. Mortenson the general contractor, and Aggregate Industries supplied the concrete.

SOLUTION AND APPLICATION
The post-tensioned structure requires approximately 20,000 cubic yards of concrete, 3,750 gallons of MCI 2005 NS and 21,875 gallons of Enduracon HR Superplasticizer. The concrete is designed to reach 3,000 PSI in 24 hours, and is pumped with an 8 inch slump. This project is to end completion in April 2002.

Calcium Nitrate (DCI) was used on the 1st two floors of the ramp and the contractors were unable to meet required 24 hour strengths w/ the superplastizer. The contractor reverted to the specified Cortec MCI 2005 NS, and met required specifications, even in the below zero temperatures. In addition there were no drying shrinkage cracks present on the Cortec MCI treated floors, as found in the DCI treated floors.

CONCLUSION
The addition of MCI 2005 NS to the parking ramp is not only going to extend the service life of the structure, but made the pour of the cement more managable without drying shrinkage cracks.

4119 White Bear Pkwy., St. Paul, MN 55110 USA
Phone (651) 429-1100, Toll free (800) 4-CORTEC
Fax (651) 429-1122, E-mail: info@cortecvci.com
www.cortecvci.com

CORTEC CORPORATION

ch 1702

South Carolina
Department of Transportation

November 20, 2001

Mr. Doug Estes
2804 Wingfield Place
Charlotte, NC 28210

Subject: Cortec's MCI 2000

Dear Doug,

This is to inform you that "Cortec's MCI 2000" is approved for SCDOT projects.

We are in the process of generating an approval sheet and policy for corrosion inhibitors.

Please let me know if you have any questions.

Sincerely yours,

Aly Hussein
Structural Materials Engineer

Post Office Box 191
Columbia, South Carolina 29202-0191

Phone: (803) 737-2214

COMBATING CORROSION

Traditionally, corrosion of reinforced concrete structures in chloride laden environments has been controlled by the use of electrochemical techniques such as cathodic protection and desalination. However, both systems are very costly to install, which in turn has led to the emergence of migrating corrosion inhibitor (MCI®) technology as a more cost-effective option.

Flexcrete recognised the growing prominence of MCI® technology in the market place and subsequently joined forces with the world leader in corrosion protection, Cortec Corporation, to offer a revolutionary impregnation coating - Cemprotec MCI® 2020. Studies have shown that this exceptional material can reduce corrosion on existing steel reinforced concrete structures by as much as a staggering 75%.

Cemprotec MCI® 2020 - a clear, waterborne coating applied by brush, roller or spray - does not need initial direct contact with steel reinforcement to dramatically reduce corrosion activity. When applied to the surface, it migrates through the pore structure of even the densest, hardened concrete to seek out embedded reinforcement and form a protective monomolecular layer on the re-bars. This barrier inhibits further corrosive attack and neutralises existing corrosion currents, thereby helping to prevent future cracking and spalling and significantly extending the life of the structure. In fact, extensive field and laboratory analysis of Cemprotec MCI®2020 has indicated that concrete treated with the coating will have an extended service life of at least 34 years.

The product is ideal for use on existing buildings, bridges, roads, tunnels, marine structures, car park decks and other reinforced concrete structures, especially those located in aggressive environments subject to high levels of chloride ions from salt water and de-icing salts.

In order to maximise the effectiveness of Cemprotec MCI® 2020, it is advisable to utilise a form of corrosion monitoring, of which linear polarisation techniques are recommended. Embedded or surface mounted probes apply external stimulation, whilst measurement of the subsequent electrical response provides the necessary data to assess the corrosion conditions. This technique is currently being used on a major Highways Agency contract at Ranby Bridge in Nottinghamshire. As a result of the presence of embedded probes, the Highways Agency can monitor corrosion by remote access via the internet.

FLEXCRETE Limited

ASTRAL House • P.O Box 7 • Miller Street
Preston • Lancashire • PR1 1EA • England

Tel: (UK) 01772 255065 • (International) +44 1772 255017

Fax: (UK) 01772 202902 • (International) +44 1772 202627

e-mail: info@flexcrete.co.uk

international e-mail: export@flexcrete.co.uk

web: www.flexcrete.co.uk

Iotech

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