MCI®

MIGRATING CORROSION INHIBITORS
FROM GREY TO GREEN

MCI® ADMIXTURES

Migrating corrosion inhibiting admixtures for reinforced structures.

Increases durability and dramatically reduces corrosion.

CORTEC CORPORATION
Environmentally Safe VpCI®/MCI® Technologies

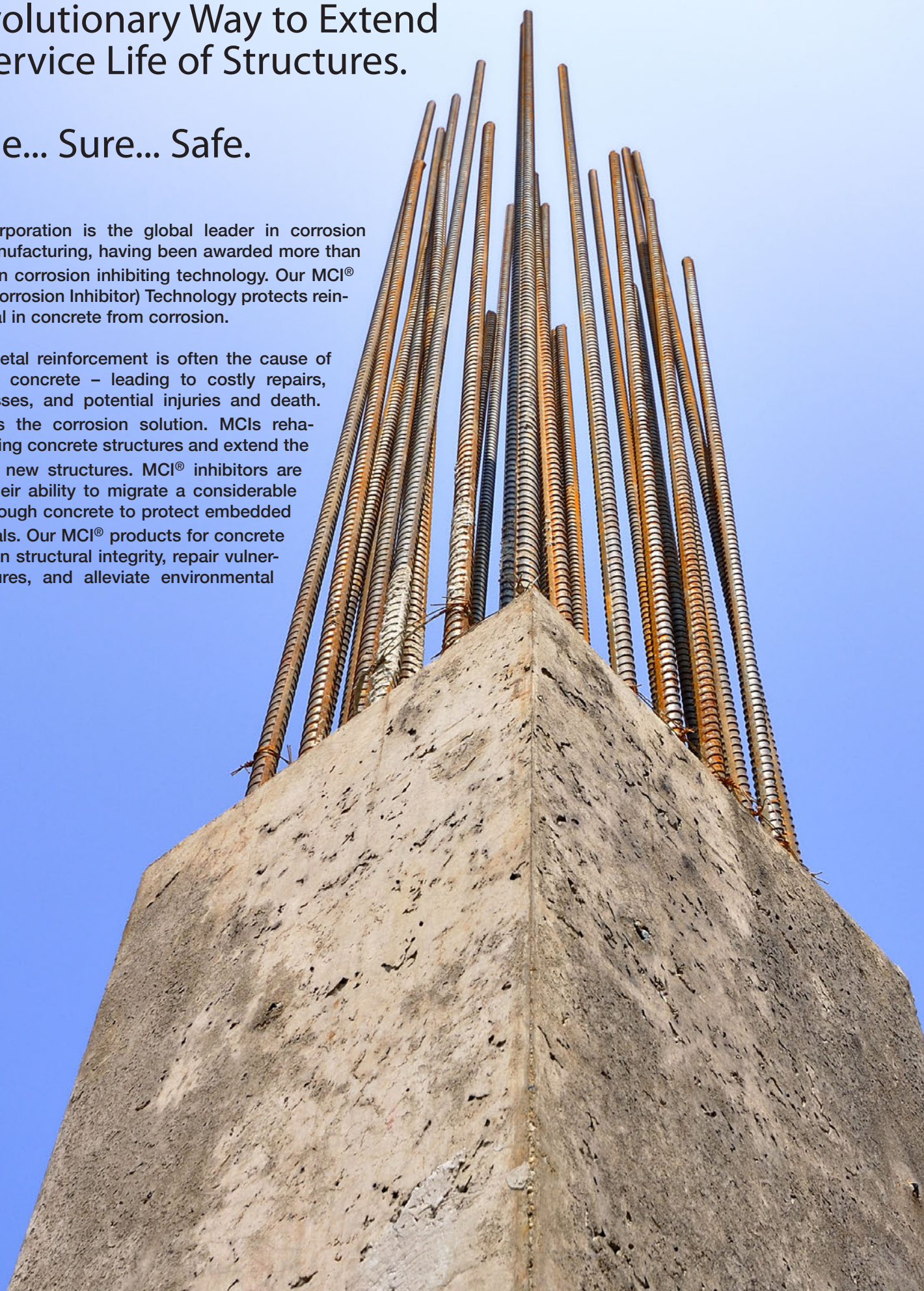
ISO/IEC-17025 LABORATORY TESTING CERTIFIED
ENVIRONMENTAL ISO 14001 CERTIFIED SYSTEM REGISTERED
ISO 9001 CERTIFIED QUALITY SYSTEM REGISTERED

A Revolutionary Way to Extend the Service Life of Structures.

Simple... Sure... Safe.

Cortec® Corporation is the global leader in corrosion inhibitor manufacturing, having been awarded more than 50 patents in corrosion inhibiting technology. Our MCI® (Migrating Corrosion Inhibitor) Technology protects reinforcing metal in concrete from corrosion.

Corroded metal reinforcement is often the cause of deteriorated concrete – leading to costly repairs, financial losses, and potential injuries and death. Cortec® has the corrosion solution. MCIs rehabilitate existing concrete structures and extend the life span of new structures. MCI® inhibitors are unique in their ability to migrate a considerable distance through concrete to protect embedded ferrous metals. Our MCI® products for concrete help maintain structural integrity, repair vulnerable structures, and alleviate environmental concerns.



Causes of Corrosion in Concrete

New concrete initially provides an excellent protective atmosphere for steel. The concrete's high alkalinity or pH causes a passive oxide film to form on steel rebar, protecting it from corrosion. However, environmental factors such as chlorides, carbonation, and industrial pollutants can lower the pH or compromise the passive oxide layer, putting reinforcing steel at greater risk for corrosion.

The corrosion process itself involves an electrochemical reaction in which parts of the rebar become active "anodic" points. Ions at these points flow to "cathodic" points where they react to form rust. Once started, the rate of corrosion is affected by the concrete's electrical resistivity, moisture content, and the rate at which oxygen migrates through the concrete to the steel. As rust formation continues, it can take up to four times the volume originally occupied by the embedded reinforcement, causing cracking and spalling of the concrete.

Chlorides

Chloride ions can penetrate the passive oxide film on concrete reinforcement. Once chlorides reach a certain level in the concrete, corrosion starts. Concrete can be exposed to chlorides from several different sources, including chloride-containing set accelerators, deicing salts, seawater, and airborne salts.

Carbonation

Carbonation is the process by which carbon dioxide in the air reacts with hydroxides (such as calcium hydroxide) in the concrete to form carbonates. This reaction significantly lowers concrete pH. When the pH of concrete surrounding embedded reinforcing steel drops below 12, the protective oxide layer is lost, and the corrosion process begins.

Acid Rain/Industrial Pollutants

Acids attack concrete by dissolving the cement paste and certain aggregates. They also reduce the pH of the concrete, allowing the corrosion process to begin, similar to the carbonation process. Pollutants such as sulfate attack the concrete by reacting with hydrated compounds in the hardened cement paste. These reactions can lead to disintegration of the concrete, making embedded reinforcement more susceptible to corrosive attack.

Once a concrete structure is built, it is impossible to coat the reinforcing steel with fusion-bonded epoxy to protect it from corrosion. Cathodic protection is expensive, requires the steel reinforcement to be electrically continuous, and must be constantly monitored. Cortec® MCI®, however, can be easily added to new concrete or used for rehabilitation. It will not delay construction or increase construction costs other than the small cost of the material. Unlike standard inorganic inhibitors, Cortec® MCIs do not have to be in direct contact with the reinforcing steel upon application because they can migrate to the steel and protect it.

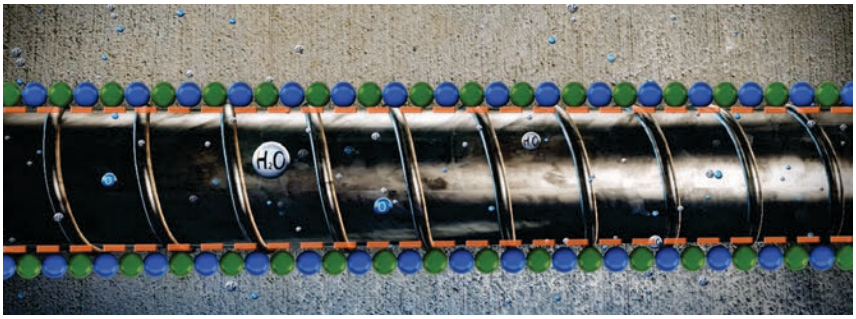
When specified in new construction, Cortec's MCI® line of concrete admixtures offers reinforcing steel superior corrosion protection against carbonation and chloride attack.

What is MCI®?

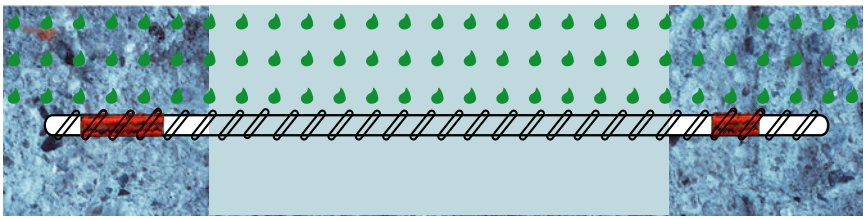
MCIs are based on amine technology (amine alcohols and amine carboxylates). They are classified as mixed inhibitors, meaning they affect both anodic and cathodic portions of a corrosion cell. MCIs adsorb onto metals, forming a protective molecular layer on metal surfaces. This film prevents corrosive elements from further reacting with embedded reinforcement and also reduces existing corrosion rates.

How Do MCI® Admixtures Migrate into Concrete?

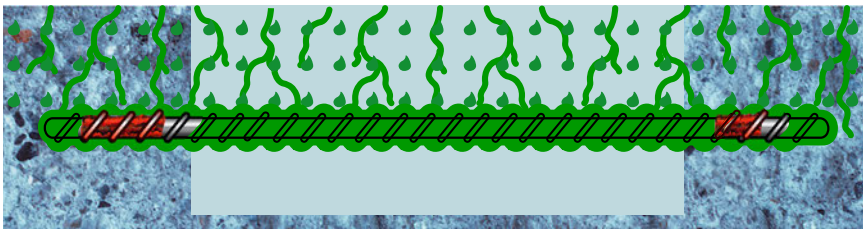
1) MCI® moves as a liquid into the concrete matrix. MCI® is admixed either with the batch water or directly into a mixer. With adequate mixing, the inhibitor is dispersed through the concrete.



2) MCI® moves in a vapor phase throughout the concrete pore structure. This movement is governed by Fick's Law, meaning molecules move randomly throughout the matrix from areas of high concentration to areas of low concentration.



3) When MCI® comes in contact with steel, it has an ionic attraction to it, and forms its protective molecular layer. MCI's affinity to the metal is stronger than water, chlorides, and other corrosive contaminants.



4) Independent testing has confirmed that MCI® can adsorb onto metal to a depth of 75-85 nm, forming a layer that is between 20 and 100 Å thick. In the same testing, chlorides were shown to penetrate only 60 nm deep. This confirmed the ability of MCI® to displace chlorides on the metal surface and provide protection even in their presence.

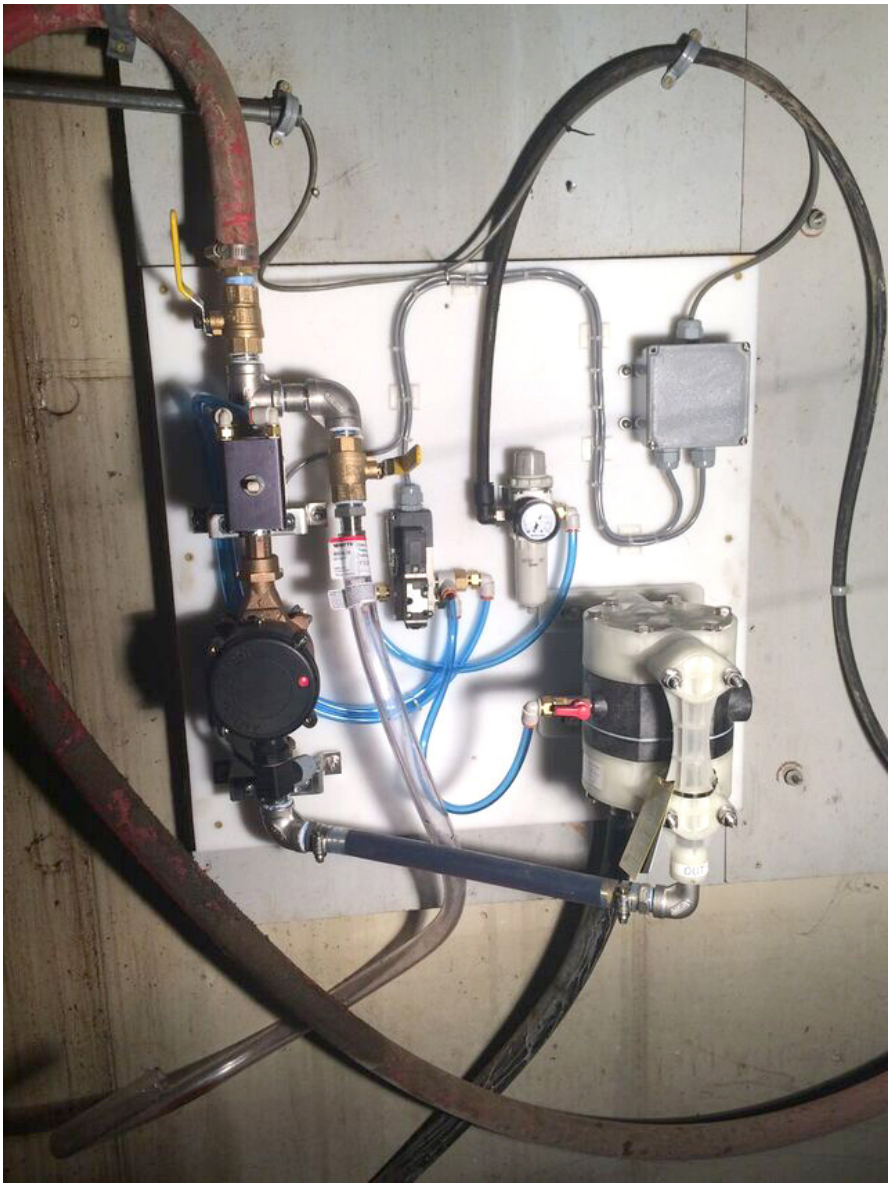
How Do You Test MCI®?

There are test methods for evaluating MCI® performance and migration into concrete. These include (but are not limited to):

- ASTM C1582 – includes testing to show that MCI® admixtures do not affect the physical properties of the mix design, as well as testing to show the inhibitor can provide corrosion protection in a chloride environment (ASTM C494, G109, G180).
- UV Spectroscopy – used to evaluate the presence and migration of MCI® inhibitors in structures.

Cortec® Admixture Dispensing Equipment

Cortec® Corporation can provide both portable and direct feed dispensing systems for dosing our admixtures into ready mix concrete.



Wall Mount Direct Feed

Portable Feed System in Protective Case

Equipment Calibration/Maintenance

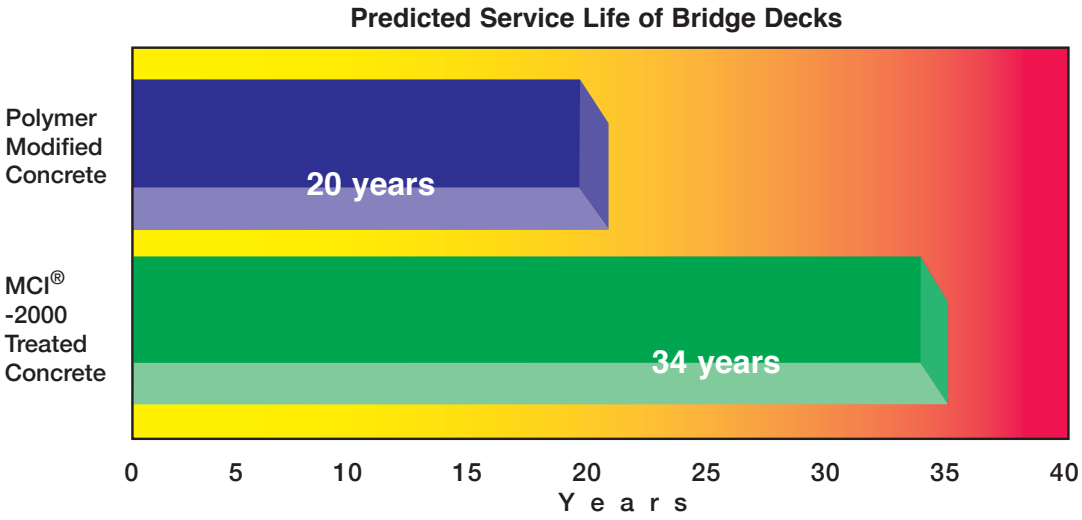
Long-Term Corrosion Studies

Proven Effective in Long-Term Independent Tests

The chemical structure of MCI® admixtures is such that they do not decompose over an extended period of time, making them effective for periods in excess of 34 years. This effectiveness has been proven in two long-term independent test programs: The Strategic Highway Research Program (SHRP) and Cracked Beam studies based on ASTM G 109.

The SHRP Program

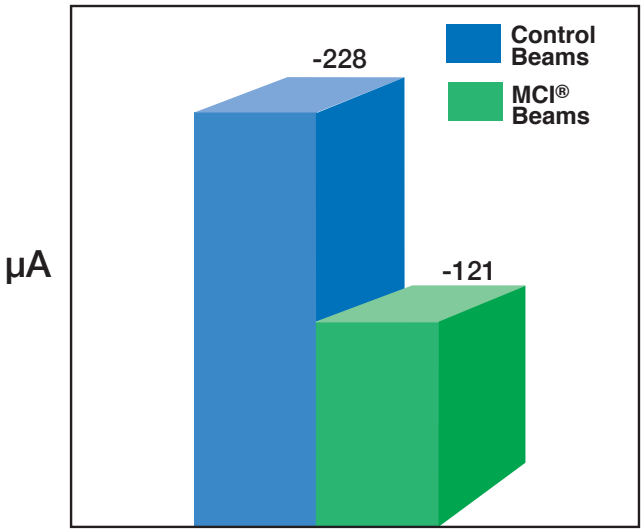
The SHRP Program involved both lab testing and actual field installation on bridges throughout the USA.
In comparison to Polymer Modified Concrete Overlays, MCI® treated concrete overlays demonstrated a dramatic extension of predicted service life.



Cracked Beam Corrosion Testing

Cracked beam tests are based on ASTM G 109. This is the standard test method for determining the effects of chemical admixtures on the corrosion of embedded steel reinforcement in concrete exposed to chloride environments.

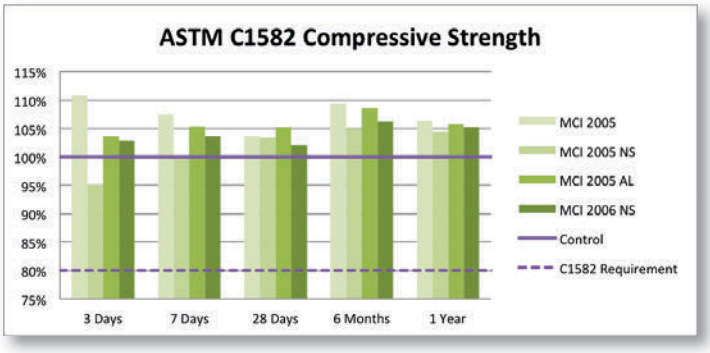
Concrete beams are cast and cracked, some containing MCI® admixtures and others not (control beams). A salt water solution is then ponded and rinsed periodically over a 1-1/2 year period. Corrosion current is measured in microamps and compared.

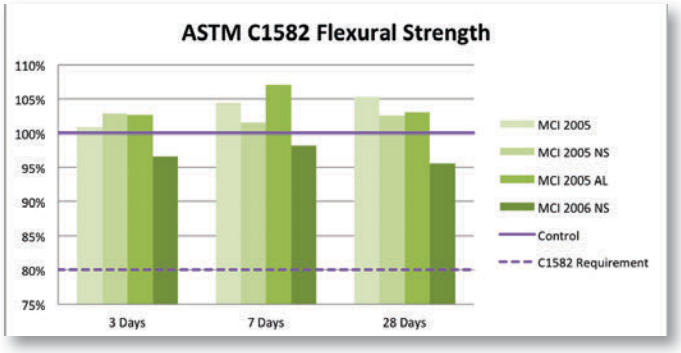


After 1-1/2 years of severe exposure corrosion, activity has significantly decreased over control specimens.

For Producing High Durability Concrete That Resists the Harmful Effects of Corrosion

MCI® corrosion inhibiting admixtures do not compromise any of the physical properties of concrete at the recommended dosage rates.





MCI®-2005					
	Control	MCI 2005	Relative to Control	ASTM C1582 Requirements	Result
Initial Set (Minutes)	312	431	+119	+/- 210 minutes of control	Meets Requirement
Final Set (Minutes)	404	524	+120	+/- 210 minutes of control	Meets Requirement
Length Change (%)	-0.025	-0.021	0.004	Max 0.010 over control	Meets Requirement
Freeze Thaw Durability	99.1%	98.8%	99.8%	RDF 80%	Meets Requirement

MCI®-2005 NS					
	Control	MCI 2005 NS	Relative to Control	ASTM C1582 Requirements	Result
Initial Set (Minutes)	308	318	+10	+/- 210 minutes of control	Meets Requirement
Final Set (Minutes)	406	419	+13	+/- 210 minutes of control	Meets Requirement
Length Change (%)	-0.0245	0.021	0.003	Max 0.010 over control	Meets Requirement
Freeze Thaw Durability	99.21	98.9	99.8%	RDF 80%	Meets Requirement

MCI®-2005 AL					
	Control	MCI 2005 AL	Relative to Control	ASTM C1582 Requirements	Result
Initial Set (Minutes)	300	344	+44	+/- 210 minutes of control	Meets Requirement
Final Set (Minutes)	396	438	+42	+/- 210 minutes of control	Meets Requirement
Length Change (%)	-0.022	-0.023	0.001	Max 0.010 over control	Meets Requirement
Freeze Thaw Durability	99.3	99.0	99.8	RDF 80%	Meets Requirement

MCI®-2006 NS					
	Control	MCI 2006 NS	Relative to Control	ASTM C1582 Requirements	Result
Initial Set (Minutes)	304	365	+61	+/- 210 minutes of control	Meets Requirement
Final Set (Minutes)	394	457	+63	+/- 210 minutes of control	Meets Requirement
Length Change (%)	-0.022	-0.023	0.001	Max 0.010 over control	Meets Requirement
Freeze Thaw Durability	98.3	98.8	99.5	RDF 80%	Meets Requirement

Cortec® MCI® Series Dramatically Reduces Corrosion in Concrete Structures. MCI® Protects Your Investment!

	Product	Description	Dosage Rate	Packaging	Applications
Aminoalcohol Based	MCI®-2000	Liquid, aminoalcohol based concrete admixture.	1 pt/yd^3 (0.62 l/m^3)	5 gal (19 l) pails, 55 gal (208 l) drums	Reinforced concrete structures such as bridges, parking garages, highways, decks and lanais.
	MCI®-2001	Powder, fumed silica/MCI®-2000 combination.	3 lb/yd^3 (1.78 kg/m^3)	5 lb (2.3 kg) boxes, 50 lb (22.7 kg) and 100 lb (45.4 kg) drums	Reinforced concrete structures such as bridges, parking garages, highways, decks and lanais.
Amine Carboxylate Based	MCI®-2005	Liquid, amine carboxylate based concrete admixture. Can retard concrete setting time 3-4 hours at 70º F (21º C). Patented.	1.0 pts/yd^3 (0.6 1/m^3)	5 gal (19 l) pails, 55 gal (208 l) drums	Reinforced concrete structures such as bridges, parking garages, highways, decks, and lanais.
	MCI®-2005 NS	Liquid, normal set version of MCI®-2005. Patented.	1.5 pts/yd^3 (1.0 1/m^3)	5 gal (19 l) pails, 55 gal (208 l) drums	Reinforced concrete structures such as bridges, parking garages, highways, decks, and lanais.
	MCI®-2006	Powder, amine carboxylate based concrete admixture. Can retard setting time 3-4 hours at 70º F (21º C). Patented.	1 lb/yd^3 (0.6 kg/m^3)	5 lb (2.3 kg) boxes, 50 lb (22.7 kg) and 100 lb (45.4 kg) drums	Reinforced concrete structures such as bridges, parking garages, highways, decks, and lanais.
	MCI®-2006 NS	Powder, normal set version of MCI®-2006. Patented.	1 lb/yd^3 (0.6 kg/m^3)	5 lb (2.3 kg) boxes, 50 lb (22.7 kg) and 100 lb (45.4 kg) drums	Reinforced concrete structures such as bridges, parking garages, highways, decks, and lanais.
	MCI® Grenades	MCI®-2006 NS powder pre-dosed into water-soluble bags for admixing into concrete. Patented.	1 grenade/yd^3	20 grenades/carton	Reinforced concrete structures such as bridges, parking garages, highways, decks, and lanais.
	MCI® Metric Grenades	MCI®-2006 NS powder pre-dosed into water-soluble bags for admixing into concrete. Patented.	1 grenade/m^3	20 grenades/carton	Reinforced concrete structures such as bridges, parking garages, highways, decks, and lanais.
	MCI® Mini Grenades	MCI®-2006 NS powder pre-dosed into water-soluble bags for admixing into mortars. Patented.	1 grenade/0.5 ft^3	100 grenades/carton	Reinforced concrete structures such as bridges, parking garages, highways, decks, and lanais. Small size for repair mortars and other low-volume jobs.
Superplasticizers with Amine Carboxylate Based MCI	MCI®-2007	Liquid, melamine based superplasticizer with MCI®. Patented.	3-4 pts/yd^3 (1.5-2 l/m^3)	5 gal (19 l) pails, 55 gal (208 l) drums	Reinforced concrete structures such as bridges, parking garages, highways, decks, and lanais.
	MCI®-2007 P	Powder, polycarboxylate based superplasticizer with MCI®.	3.5-6.0 oz/100 lb (5-9 kg/m^3) by weight of cement	5 lb (2.3 kg) boxes, 50 lb (22.7 kg) and 100 lb (45.4 kg) drums	For use in self leveling, self compacting concrete mix designs, particularly 'low' or 'no' slump applications. Reinforced concrete structures such as bridges, parking garages, highways, decks, and lanais.
	MCI®-2008 ViaCorr	Powder, polycarboxylate based superplasticizer for self compacting, self leveling concrete with MCI®.	0.4-0.6% by total weight of concrete mix.	5 lb (2.3 kg) boxes, 50 lb (22.7 kg) and 100 lb (45.4 kg) drums	For use in self leveling, self compacting concrete mix designs, particularly 'low' or 'no' slump applications. Reinforced concrete structures such as bridges, parking garages, highways, decks, and lanais.
	MCI®-2008 L	Liquid, polycarboxylate based superplasticizer for self compacting, self leveling concrete with MCI®.	0.4-0.6% by total weight of concrete mix.	5 gal (19 l) pails, 55 gal (208 l) drums	For use in self leveling, self compacting concrete mix designs, particularly 'low' or 'no' slump applications. Reinforced concrete structures such as bridges, parking garages, highways, decks, and lanais.

Visit our website for more information on MCI®. **www.CortecMCI.com**

Total Corrosion Control

Cortec® Corporation is dedicated to controlling corrosion at ALL STAGES of a product life cycle. Cortec® has developed a diverse range of corrosion protection products including cleaners, metalworking fluids, water- and oil-based coatings and corrosion inhibitors, rust removers, paint strippers, powders, packaging foams, paper, films and surface treatments and admixtures for concrete. Contact Cortec® for additional brochures and information.

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.

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CORTEC CORPORATION
Environmentally Safe VpCI®/MCI® Technologies

4119 White Bear Parkway, St. Paul, MN 55110 USA
Phone (651) 429-1100, Fax (651) 429-1122
Toll Free (800) 4-CORTEC, E-mail info@cortecvci.com
Internet http://www.CortecMCI.com

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