MIGRATING CORROSION INHIBITORS
FROM GREY TO GREEN

03 01 00	Maintenance of Concrete Reinforcing
05 03 12.23	Conservation Treatment for Period Structural Steel for Buildings

MCI®-2020 / MCI®-2020 V/O

DESCRIPTION

MCI®-2020 is a surface-applied, Migrating Corrosion Inhibitor™ designed to penetrate through cementitious materials including concrete, mortar, and limestone. MCI®-2020 migrates in both liquid and vapor (gas) phases through the pore structure, forming a protective molecular layer on embedded reinforcement. MCI®-2020 provides corrosion protection against carbonation, chlorides, and other contaminants. MCI®-2020 V/O is a high viscosity version of MCI®-2020 that is specifically designed for vertical and overhead applications.

PACKAGING & STORAGE

MCI®-2020 and MCI®-2020 V/O are available in 5 gallon (19 liter) pails, 55 gallon (208 liter) drums, and 275 gallon (1040 liter) totes.

MCI®-2020 and MCI®-2020 V/O are also available with a blue fugitive dye (MCI®-2020 BFD and MCI®-2020 V/O BFD), which helps to easily identify treated areas.

To ensure best product performance, store in original packaging, indoors, and out of direct sunlight at 40-100 °F (4-38 °C).

Shelf life: 2 years

HOW IT WORKS

MCI®-2020 and MCI®-2020 V/O are organic corrosion inhibitors. They are considered ambiodic (mixed) inhibitors which means they protect both anodic and cathodic areas within a corrosion cell. MCI®-2020 and MCI®-2020 V/O contain a synergistic blend of amino-alcohols and salts of carboxylic acids, which form a protective layer on embedded reinforcement, delaying the onset of corrosion as well as reducing existing corrosion rates.

WHERE TO USE

MCI®-2020 and MCI®-2020 V/O are recommended for:

- Preventative maintenance of existing reinforced, precast, prestressed, post-tensioned, or marine concrete structures
- Bridges, highways, and industrial floors exposed to aggressive environments (chemicals, deicing salts, carbonation, atmospheric attack)
- Parking garages
- Concrete piers, dams, offshore platforms, piles, pillars, pipes, utility poles, and cooling towers
- Concrete potable water structures
- As a component of Cortec's High Performance Repair System™ (HPRS®)

ADVANTAGES

MCI®-2020 and MCI®-2020 V/O offer engineers, owners, contractors, DOTs, and other government agencies a time-proven corrosion inhibiting technology that will extend the service life of their reinforced concrete structures.

- Protects against corrosion caused by carbonation, chlorides, and other aggressive contaminants
- Effectively reduces corrosion rates on metals with existing corrosion
- Certified to meet ANSI/NSF Standard 61 for structures containing potable water
- Complies with EN 1504-9: Products and Systems for the Protection and Repair of

MCI®-2020 / MCI®-2020 V/O

Concrete Structures, Principles 9 and 11
- MCI®-2020 AND MCI®-2020 V/O technology recognized in ICRI Guideline 510.2-2019 as a surface applied corrosion inhibitor (SACI)
- Water-based and non-flammable
- Does not etch, stain, discolor, or otherwise harm glass, metals, or automotive paint
- Does not contain calcium nitrite
- Does not contain wax
- Does not require removal of sound concrete
- Allows vapor diffusion (not a vapor barrier)
- Easily applied by spray, brush, or roller
- Minimal curing time; traffic may resume minutes after application if necessary (dry to touch)
- Migrates independent of orientation (horizontal, vertical, overhead)
- Migrates up to 3 inches (7 cm) in 30 days
- Proven performance in both lab and field testing
- MCI®-2020 V/O available for vertical and overhead surfaces
- UFI: 8GTX-T1F1-AU1R-RYU9

PHYSICAL PROPERTIES

MCI®-2020

Appearance	Clear to slightly hazy, amber liquid
pH	9-9.7 (neat)
Density	8.6-8.8 lb/gal (1.03-1.05 kg/L)
Water Vapor Transmission	1.72 perms (TCG Project # 09146)
NVC	20-27%
Shelf Life	24 months in sealed container
Storage	32-150 °F (0-65 °C)

MCI®-2020 V/O

Appearance	Clear, yellow, viscous liquid
pH	9-10 (neat)
Density	8.6-8.8 lb/gal (1.03-1.05 kg/L)
NVC	20-27%
Shelf Life	24 months in sealed container
Storage	32-150 °F (0-65 °C) Do NOT Freeze

COVERAGE

MCI®-2020 is applied in a single coat at 150 ft^2/gallon (3.68 m^2/liter) to horizontal surfaces. It is applied in two coats at 300 ft^2/gallon (7.36 m^2/liter) to vertical and overhead surfaces. MCI®-2020 V/O is applied in a single coat at 150 ft^2/gallon (3.68 m^2/liter) on most surfaces. In the case of dense overhead surfaces, it can also be applied in two coats at 300 ft^2/gallon (7.36 m^2/liter).

PERFORMANCE DATA

Performance of MCI®-2020/MCI®-2020 V/O has been confirmed in many lab and field studies. Testing has confirmed its corrosion rate reduction ability, even in the presence of chlorides, as well as its ability to migrate into a structure from the surface of concrete and to form a protective layer on embedded reinforcing steel.

Study 1: Penetration into Concrete, Film Forming Capability, Chloride Displacement, Corrosion Mitigation

California State University - Northridge performed corrosion rate testing followed by Scanning Electron Microscopy (SEM) analysis, Energy-Dispersive X-Ray (EDX) spectroscopy, and X-Ray Photoelectron Spectroscopy (XPS) depth profiling analysis on MCI®-2020 treated samples. According to corrosion rate testing, MCI® protected samples had an average current density of 0.4 µA/cm^2, about ¼ the rate of the untreated samples, which had an average current of 1.4 µA/cm^2. This reduction was estimated to increase the service life expectancy by more than 15 years.

SEM and EDX analysis were performed on embedded steel taken from control (untreated) and treated samples. Nitrogen (N), is contained in the MCI®-2020 active ingredients. As is shown in the chart below, the control samples only have trace amounts of nitrogen, whereas treated samples have a much larger presence of nitrogen indicating the active inhibitor has reached the steel surface. The chart also shows the presence of chloride at the surface. The treated samples had less chloride on average at the surface than the control samples.

Finally, XPS depth profiling showed chloride present at 60 nm depth on the rebar surface, whereas nitrogen was present at 75 nm deep, confirming the ability of the inhibitor to adsorb deeper into the metal than chloride to provide corrosion protection, whereas untreated samples were subject to localized corrosion attack.

Mass Concentration (%)								
Sample	Etch Time (seconds)	Fe 2p	O 1s	C 1s	N 1s	Cl 2p	Ca 2p	Si 2p
Untreated	0	6.27	42.71	30.67	0.19	1.07	14.19	4.97
Untreated	120	13.6	39.43	23.08	0.14	1.06	17.59	5.19
Untreated	240	14.65	38.77	22.35	0.11	1.01	18.18	5.03
L2020	0	2.3	42.22	29.9	1.16	0.95	17.28	6.26
L2020	120	2.53	43.01	25.17	1.12	0.93	20.14	7.18
L2020	240	2.56	43.85	21.95	1.05	1.4	22.19	7.09
L2020M	0	2.02	40.2	38.55	1.32	0.87	11.54	5.53
L2020M	120	2.22	41.74	32.13	1.29	0.86	15.41	6.42
L2020M	240	2.82	43.61	28.99	1.15	0.83	15.92	6.68

Bavarian, Behzad, PhD. and Reiner, Lisa. The Efficacy of using Migrating Corrosion Inhibitors (MCI®-2020 & MCI®-2020 M) for Reinforced Concrete. California State University, Northridge, College of Engineering and Computer Science. March 2004.

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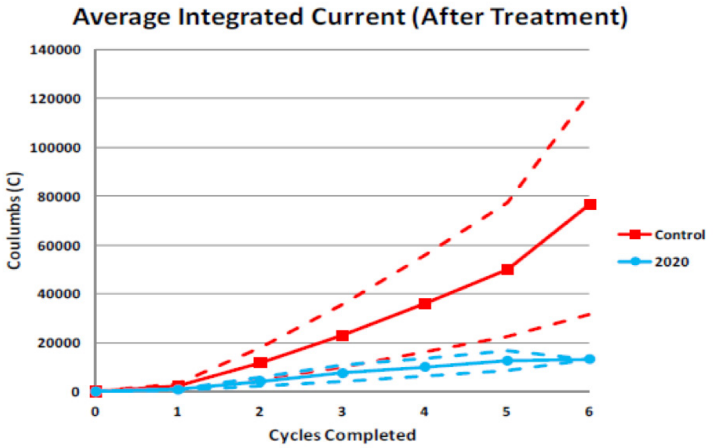
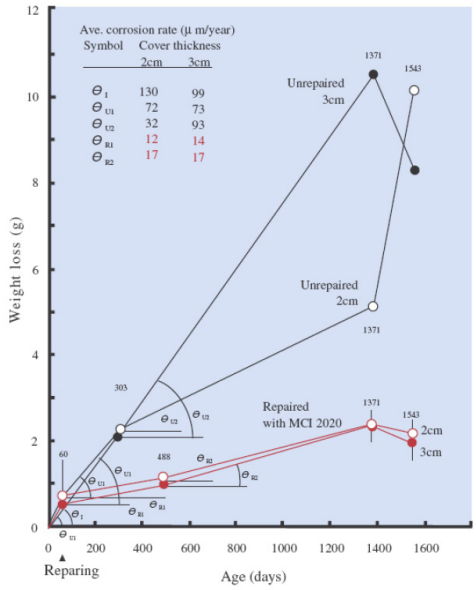
Study 2: Corrosion Protection in Chloride Contaminated Structures

MCI®-2020 has been tested under the USBR M-82 (M0820000.714) protocol to evaluate its corrosion mitigation performance in the presence of chloride. Results shown are that of MCI®-2020 applied before a standard 40% silane water repellent.



Results of the US Bureau of Reclamation M-82 (M0820000.714) Standard Protocol to Evaluate the Performance of Corrosion Mitigation Techniques in Concrete Repairs. Results are of MCI®-2020 applied under a standard sealer.

The General Building Research Corporation of Japan also evaluated MCI®-2020's ability to decrease corrosion currents in the presence of chlorides. MCI®-2020 treated specimens decreased the amount of corrosion by 1/2 to 1/6 that of control samples. Applying MCI®-2020 after cracks appeared worked very well to reduce corrosion rates in samples.

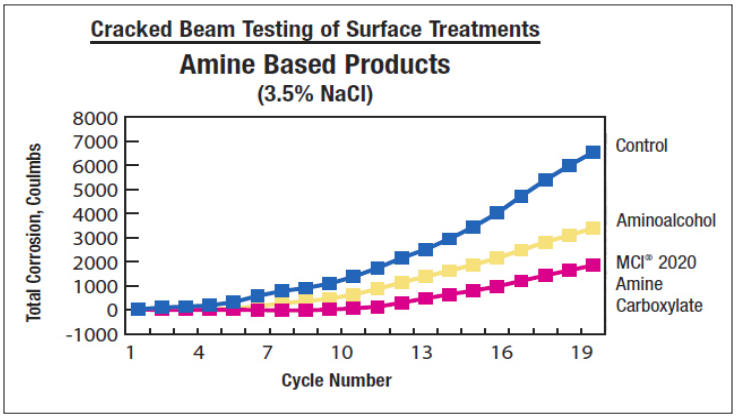


Nagayama, Dr. Masaru and Shimozawa, Mr. Kazuyuki. Long Term Corrosion Testing of MCI®-2020 (November 1994-April 1999). General Building Research Corporation of Japan. April 1999.

Study 3: Corrosion Rate Reduction in Cracked Areas

Wiss, Janney, Elsner (WJE) performed modified ASTM G109 testing on MCI®-2020. ASTM G109 beams were cast to include a crack over the top bar so that chlorides reached the steel immediately when samples were ponded with sodium chloride solution. MCI®-2020 reduced corrosion currents by 72% compared to control samples and also outperformed the amine alcohol based surface treatment.

Sherman, Matthew R. and Krauss, Paul D. Cracked-Beam Corrosion Tests



of Concrete Treated with MCI®-2000 and MCI®-2020 Corrosion Inhibitors, Final Report, WJE No. 922041. January 1995.

SURFACE PREPARATION

Surfaces should be dry, clean, and free of all oil, grease, efflorescence, water repellents, coatings, membranes, and asphalt. Cleaning may be done by steam cleaning, waterblasting, or sandblasting.

APPLICATION

Apply MCI®-2020/MCI®-2020 V/O via spray, brush, or roller according to coverage rates listed above. When spraying MCI®-2020/MCI®-2020 V/O, Cortec® recommends using conventional air assisted or airless spray equipment. For air assisted equipment, air pressure is recommended to be between 30 and 50 psi with use of a 0.019-0.030" (0.5-0.8 mm) sized spray tip. MCI®-2020 can also be applied using hand pressure spray equipment. If applying more than one coat, allow the surface to dry enough between applications so that the second coat penetrates into the surface within 15 minutes. When applying a water repellent, coating, repair mortar, or overlay over MCI®-2020/MCI®-2020 V/O, the surface should be rinsed with water, pressure washed, or blast-cleaned to remove any residue unless prior adhesion testing has been performed. Consult product specifications for more detailed application instructions.

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CONSIDERATIONS

- Substrate and ambient temperature should be above 35 °F (2 °C) and below 125 °F (50 °C)
- Do not apply if temperature is expected to fall below 32 °F (0 °C) within 12 hours after application
- MCI®-2020/MCI®-2020 V/O will not penetrate water repellents, coatings, paints, membranes, or asphalt
- If structure will be submerged after application of MCI®-2020/MCI®-2020 V/O, it is recommended to use a waterproofing coating over MCI®-2020/MCI®-2020 V/O prior to submersion
- Maximum chloride content at the depth of reinforcement in structures being treated with MCI®-2020/MCI®-2020 V/O is 6 lb/yd^3 (3.5 kg/m^3); for higher levels, consult Cortec® Technical Service
- Do not apply if precipitation is expected within 8 hours after application

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