NEWS ALERT

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New Cortec® White Paper Details MCI® Admixtures for Extended Concrete Service Life

A new Cortec® white paper discusses the opportunity to "Prolong Reinforced Concrete Service Life with MCI® Admixtures." Written by experts on Cortec® Migrating Corrosion Inhibitor™ (MCI®) Technology, the paper briefly details the characteristics, test data, and capabilities of MCI® admixtures to mitigate corrosion and extend service life of reinforced concrete structures.

After describing the unfortunate corrosion problem facing reinforced concrete, the white paper delves into the basic technology of non-hazardous, nitrite-free MCI® Admixtures. These admixtures consist of both volatile (vapor phase) and contact corrosion inhibitors. Many are certified to meet NSF Standard 61 for potable water applications, and some are biobased. MCI® molecules work by adsorbing on steel surfaces and forming a hydrophobic layer that protects the steel from water and other corrosive species.

The paper outlines test result data regarding several dimensions of MCI® admixtures:

- ASTM G180 – MCI® increased corrosion resistance by 10 Rp
- XPS – Presence of MCI® was indicated at the rebar surface, with a correspondingly lower level of chlorides
- Cracked Beam Testing – MCI® demonstrated a more significant reduction of corrosion rates compared to other common corrosion inhibiting admixtures

The white paper also answers several questions on whether MCI® admixtures conform to construction industry standards (they do), how much MCI® can extend concrete service life (by as much as 50 years), and where MCI® is beneficial (in all reinforced concrete structures exposed to corrosive environments).

In conclusion, the paper states: "MCI® admixtures provide a safe, environmentally friendly, and economical tool to fight corrosion and extend durability and service lives of your reinforced concrete structures."

To learn more about the details of MCI® admixtures, please continue to read the full white paper below!

Prolong Reinforced Concrete Service Life with MCI® Admixtures

Problem

Reinforced concrete is the most widely-used construction material in the modern world. Embedded steel reinforcement significantly increases tensile strength of concrete, making concrete a versatile, economical, and structurally-robust building material. The other side of the coin is that embedded steel can also shorten concrete service life if not treated properly. Due to concrete porosity and the frequent occurrence of settlement cracks, corrosive species can ingress into concrete and cause embedded steel to corrode. The corrosion products expand in volume, as much as six to eight times the original steel volume. Over time, the accumulation of corrosion product can cause concrete to crack or spall further and eventually lead to complete structural failure, threatening human life.

It is not uncommon to witness the premature demise of reinforced concrete in our daily lives. Structures with shortened service life also pose environmental hazards with costs involved in removing and disposing the waste. The manufacturing process of cement, a key concrete ingredient, takes tremendous energy and generates considerable greenhouse gas. Effectively designed concrete with a long service life can greatly mitigate the harm of corrosion.

Solution

Migrating Corrosion Inhibitor™ (MCI®) admixtures can help your new concrete structures avoid premature failure due to corrosion of steel reinforcement. Using MCI® admixtures saves money and reduces liability for asset owners. It also contributes to a "greener" world.

What are MCI® admixtures?

MCI® admixtures are developed, manufactured, and marketed by Cortec® Corporation, an American company based in St. Paul, Minnesota. Generally they consist of two functional components: volatile corrosion inhibitors and contact corrosion inhibitors, some of which are amino carboxylates. The MCI® admixtures are non-hazardous and nitrite free. Many are certified to meet NSF Standard 61

for potable water applications (tested by Underwriters Laboratories). Some are made with agriculture byproducts and are USDA Certified Biobased. MCI® admixtures are effective at very low doses.

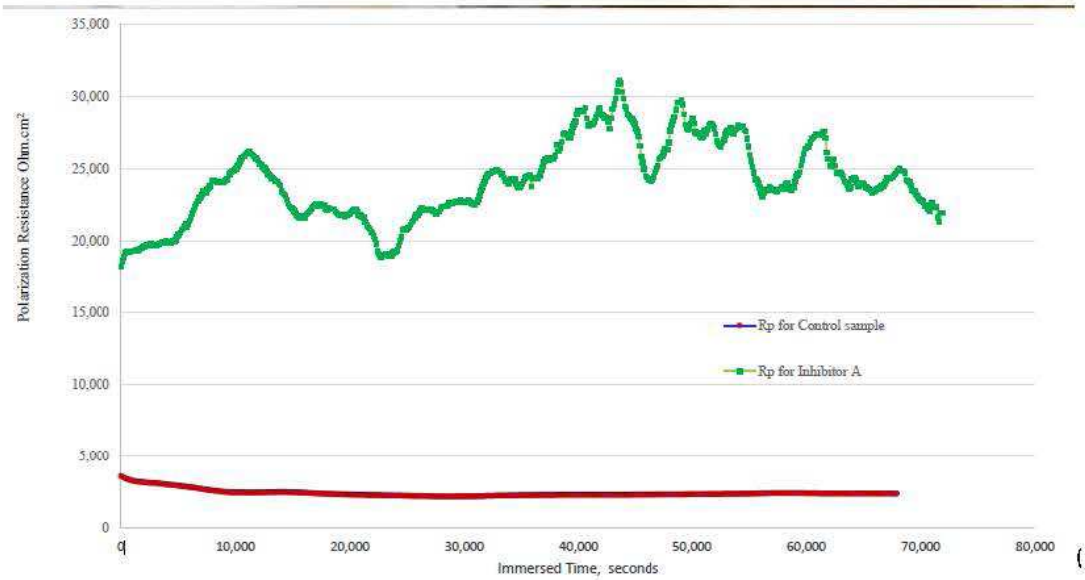
How does MCI® work?

MCI® works by forming a protective molecular layer on steel surfaces. One part of the MCI® molecule has affinity to metal and gets adsorbed on the metal surface. Another part of the MCI® molecule possesses hydrophobic properties (is water hating). This component forms a hydrophobic layer on metal surfaces and repels water and other corrosive species, thereby functioning as a barrier layer.

What test data show MCI® works?

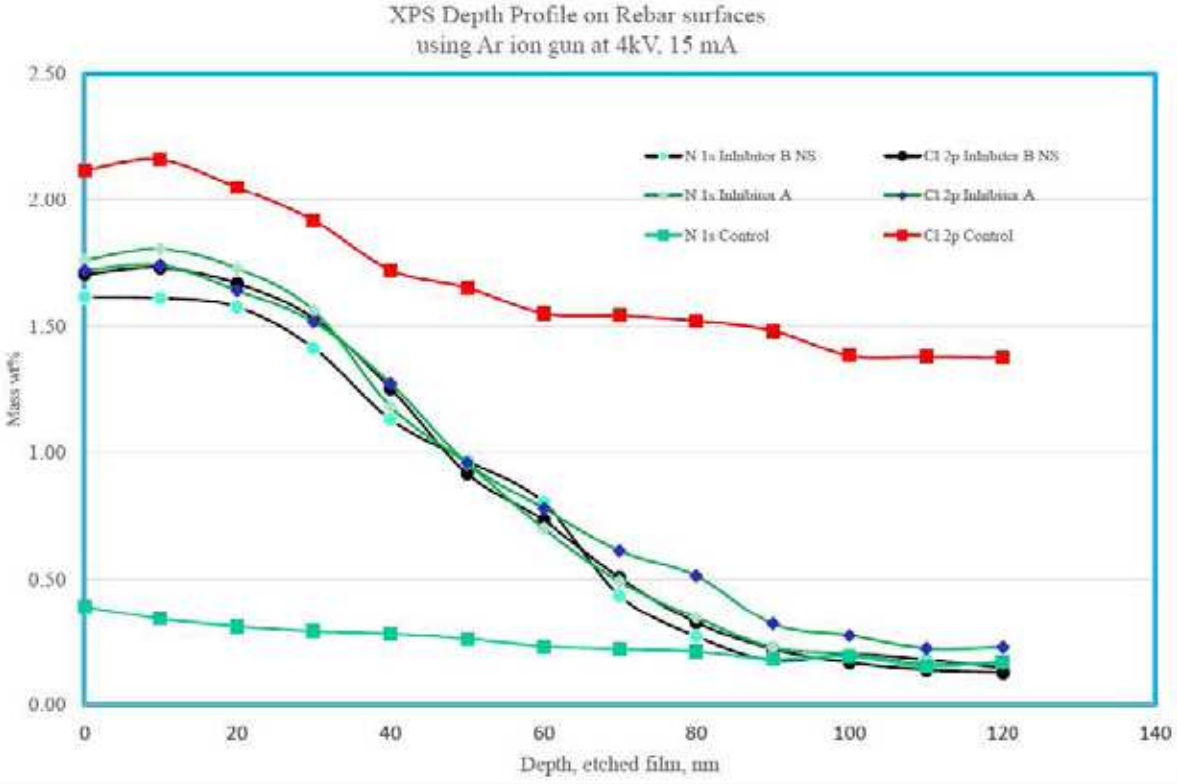
- MCI® Admixtures pass ASTM G180, "Standard Test Method for Corrosion Inhibiting Admixtures for Steel in Concrete by Polarization Resistance in Cementitious Slurries," which specifies a valid admixture must increase corrosion resistance Rp by at least eightfold compared to a control.

  The graph below shows that the average corrosion resistance Rp of a rebar immersed in concrete slurry treated with MCI® Inhibitor A is about 25 Kohms (green line). It is 10 times the Rp of a rebar immersed in concrete slurry without MCI® (red line, about 2.5 Kohms).



(1)

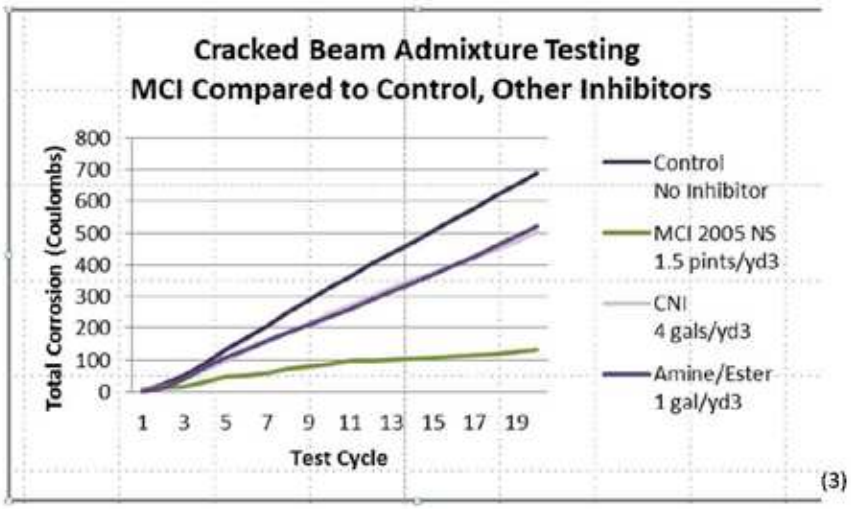
- XPS (X-ray photoelectron spectroscopy) analysis demonstrated the presence of amino carboxylate based inhibitors on steel rebar surfaces (as nitrogen-rich components) embedded in MCI® treated concrete, indicating their migration from concrete into the rebar surface layer as shown in the graph below. Almost no nitrogen, and thus no amino carboxylate, was detected in steel rebar surfaces embedded in concrete without MCI®.



(2)

The XPS depth profile graph on rebar surfaces also indicates that the level of corrosive chloride on rebar surfaces is much lower in MCI® treated concrete (purple and dark green lines) versus the control (red line). This is attributed to the MCI® barrier layer which effectively impeded the penetration of chloride.

- Cracked Beam Testing demonstrated that MCI® can provide protection in the presence of hairline cracks and reduce embedded rebar corrosion rates much more significantly than other commonly used corrosion inhibiting admixtures.



Do MCI® admixtures conform to construction industry standards?

Yes. MCI® admixtures pass construction standard ASTM C1582, "Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete." This standard incorporates many other ASTMs within it, including tests to show any effects the admixture may have on the physical properties of the concrete mix, as well as demonstrating corrosion protection in the presence of chlorides.

How much can MCI® admixtures extend concrete service life?

MCI® delays the onset of corrosion compared to a control mix (can double the time to when corrosion begins). Once corrosion initiates, it can reduce the rate of corrosion by 5-13 times compared to a control. Mix designs vary in expected performance and service life expectations, but using these parameters, MCI® should extend service life up to 50 years more than a comparable control mix.

Where are MCI® admixtures beneficial?

- All reinforced concrete including precast, pre-stressed, and post-tensioned structures
- Reinforced concrete exposed to corrosive environments including deicing salts, saline groundwater, airborne chlorides, and carbonation

- Marine and coastal structures, highways and bridges, parking decks, pilings, substructures, piers, pillars, pipes, and utility poles

Where can one get more information on MCI® admixtures?

Contact Jessi Meyer at jmeyer@cortecvci.com.

Summary

MCI® admixtures provide a safe, environmentally friendly, and economical tool to fight corrosion and extend durability and service lives of your reinforced concrete structures.

Image Sources:

(1)(2) Behzad Bavarian, Akinbosede Oluwaseye, and Lisa Reiner. "Improving Durability of Reinforced Concrete Structures using Migrating Corrosion Inhibitors as Admixtures." California State University, Northridge. Presented at NACE Corrosion 2017 Conference and Expo.
(3) Jessi Meyer, Cortec® Corporation. Data taken from "Report of Concrete Corrosion Inhibitor Testing," American Engineering Testing, Inc., August 13, 2003.