TECH**NOTE**

TECHNIQUES TO INHIBIT CORROSION IN BRIDGE DECK REINFORCEMENT PRIOR TO OVERLAY INSTALLATION

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OBJECTIVE

Corrosion of steel reinforcement is one of the primary contributing factors to bridge deck deterioration. Depending on its severity, different corrosion-inhibiting strategies can be used to increase the service life of a bridge deck. One strategy is to apply a bridge deck overlay. To date, a number of different overlay solutions are commonly deployed, including concrete-based and polymer-based systems. Additionally, in recent years, bridge owners have become increasingly interested in ultra-high performance concrete (UHPC) overlays. Another strategy commonly used in conjunction with overlays is to apply corrosion-inhibiting chemicals and sealers to reduce the ingress of deleterious ions. The primary objective of this document is to explore a series of techniques to inhibit the corrosion of existing reinforcement in conventional concrete bridge decks prior to installing an overlay, with an emphasis on UHPC overlays. The secondary objective is to assess the bond strength between the overlay and the concrete substrate in the presence of these different corrosion-inhibiting techniques.

INTRODUCTION

Background

Deterioration of bridge decks across the United States can largely be attributed to the synergistic exposure to aggressive environmental conditions, deicing operations, and repeated traffic loading. The result of these actions can range widely and are highly dependent on numerous factors described in the literature (Ellingwood 2005). The deterioration mechanism most relevant to this document is corrosion of the bridge

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deck's steel reinforcement. Corrosion of reinforcing steel causes the bars to lose their cross-sectional area, and the formation of iron oxide is a major contributing factor to the delamination and spalling of cover concrete, both of which result in reduced deck capacity (Kayser and Nowak 1989). Preservation or maintenance actions are typically required as the delamination and spalling of cover concrete become more widespread, causing the deck's condition rating to decline. These actions might take the form of localized removal and patching of concrete or could require a more thorough approach, such as a bridge deck overlay.

Bridge deck overlays are a common bridge deck preservation strategy. They can be used to maintain or extend service life and upgrade a deck's condition rating (Krauss, Lawler, and Steiner 2009). Common overlay solutions include high-density or microsilica concretes, high performance concretes, latex-modified concretes (LMC), and asphalt with waterproofing membranes. Several different polymer-based solutions are also available on the market. Recently, U.S. interest in the use of UHPC overlays has grown due to positive experiences reported from Europe (Brühwiler and Denarie 2013). Presently, 17 bridges in the United States employ UHPC overlays (FHWA 2021). Some of these bridges are long-span signature structures (FHWA 2021). Graybeal and Haber (2018) reported additional information on UHPC overlays for bridge decks in the United States.

Regardless of the overlay solution selected, the following question must be addressed: What action should be taken if there is evidence or a high probability that reinforcement corrosion is occurring? The common approach is to try to slow down or inhibit the corrosion process. The corrosion protection strategies for steel reinforcing bars embedded in concrete include corrosion inhibitors, surface protection systems, and sealers. Corrosion inhibitors are substances that, when added in small quantities to the concrete in an aggressive environment, reduce the corrosion rate of a particular metal in that environment. Sealers are used to reduce the ingress of deleterious ions, moisture, and oxygen.

This TechNote investigates the use of corrosion inhibitors and sealers in conjunction with the application of bridge deck overlays to inhibit ongoing corrosion of steel reinforcement on an in service bridge deck. The laboratory investigation presents corrosion rate measurements to assess the corrosion activity in reinforced concrete slab specimens designed to simulate an in service bridge deck. Prior to the application of either an LMC or UHPC overlay, different sealers and/or corrosion-inhibiting chemicals were applied to the concrete substrate. Specimens were subjected to a 3-percent sodium chloride solution while corrosion rate measurements were taken. After 110 weeks of exposure, the overlay-to-concrete bond performance was assessed to investigate the effect of each of the corrosion-inhibiting techniques.

Previous Research

This section presents a summary of several studies that have been conducted on the application and effectiveness of corrosion inhibitors and sealers on concrete bridge decks.

Corrosion inhibitors can be applied before or after the placement of concrete. Research has demonstrated that applying corrosion inhibitors at the time of concrete placement is more effective than installing inhibitors at a later stage (El-Hacha, Cook, and Rizkalla 2011). El Hacha, Cook, and Rizkalla (2011) observed in their study that the corrosion inhibitors delayed the corrosion process and were more effective at lower levels of chloride contamination. Sealers are applied to the surface of the concrete deck after the placement and adequate curing of concrete or after many years of service. The application of protective sealers prior to chloride contamination has been found to prevent corrosion initiation, but sealers have been shown to be less effective in cases where there is ongoing corrosion (Tabatabai, Pritzl, and Ghorbanpoor 2009). In some cases, the penetration depth of the sealer has been found to be an additional factor that influences sealer performance. Pincheira and Dorshorst (2005) reported that sealers with greater penetration depth resulted in better protection against chloride ingress. Other studies have shown no correlation between chloride penetration and the depth of sealant penetration (Basheer, Cleveland, and Long 1998).

Information about the long-term effectiveness of sealers and corrosion inhibitors is limited. Pritzl et al. (2015) assessed the long-term performance of sealers and corrosion inhibitors by measuring chloride profiles in multiple bridge decks in Wisconsin after 12 to 16 years of service. Results from that study indicated that chloride profiles obtained from bridge decks treated with sealers at the time of construction were similar to those obtained from untreated decks. Pritzl et al. (2015) also found that surface chloride penetration was significantly reduced when sealers were reapplied periodically. In the Pritzl et al. (2015) study, some sealers were reapplied every 4 years. The effect of corrosion inhibitors on the diffusion coefficients was greatly affected by the permeability of the concrete. The diffusion coefficients of low permeability concrete were not significantly affected by the use of corrosion inhibitors (Pritzl, Tabatabai, and Ghorbanpoor 2015). Another study conducted by the Virginia Transportation Research Council (VTRC) demonstrated that corrosion inhibitors were not effective in reducing corrosion activity when applied to bridge decks prior to the installation of overlays and patch repairs. Additionally, the VTRC investigated the effect of corrosion inhibitors on the overlay bond strength to the substrate concrete. Results indicated that the topical application of inhibitors did not affect short-term bond strength. However, the results also demonstrated an apparent reduction in long-term bond strength that was attributed to the high-chloride content in the substrate concrete (Sprinkel 2003).

EXPERIMENTAL DETAILS

The following sections outline the materials, methods, and details of the experiments conducted for this TechNote.

Materials

Reinforcing Steel

Steel reinforcing bars were of ASTM A615 grade 60 U.S. #4 (grade 420 M13) (ASTM 2020a).

Corrosion-Inhibiting Chemicals

Four different corrosion-inhibiting chemicals were used in this study. The handling and application of these chemicals followed manufacturer recommendations:

- **Soy-based sealer (S):** Single-part liquid product that includes a polystyrene blended in a soy methyl ester solvent that is applied to the concrete surface. The polystyrene precipitates blocking the pores and the potential to bind chlorides. The sealer was applied in two coats using a brush about 24 hours prior to the application of the overlay to allow for it to dry and penetrate.
- **Amino alcohol-based corrosion inhibitor (CI):** Single-part liquid product designed to penetrate the concrete surface and then diffuse in vapor or liquid form to the rebar level for additional protection. This corrosion inhibitor was applied in two coats using a brush. A minimum of 1 hour wait time was maintained between each coat. The product was applied about 24 hours prior to the application of the overlay to allow for it to dry and penetrate.
- **Hybrid silane-based sealer and corrosion inhibitor (SCI-1):** Single-part liquid product designed to penetrate the concrete surface down to the rebar level and form a protective layer on the steel surface that inhibits corrosion. This product was applied in two coats using a brush about 24 hours prior to the application of the overlay to allow for it to dry and penetrate.
- **Hybrid silane-based sealer and corrosion inhibitor (SCI-2):** Single-part liquid product designed to penetrate the concrete surface down to the rebar level and form a protective layer on the steel surface that inhibits corrosion. This product was applied in two coats using a brush about 24 hours prior to the application of the overlay to allow for it to dry and penetrate. The research team waited at least 15 min between each coat.

Substrate Concrete

The substrate concrete mix design was based on a common bridge deck concrete mixture used in the State of Virginia. Class A4 concrete was based on Virginia Department of Transportation (VDOT) specifications (VDOT 2016). The reactive component of the mixture included type I/II portland cement and Class F fly ash. Fly ash was used as partial replacement for portland cement with a mass fraction of 35 percent. The concrete was designed to have a water-to-cementitious materials ratio (w/cm) of 0.43 and fine and coarse aggregate volume contents of 26 percent and 38 percent, respectively. Fine aggregates had an absorption capacity of 0.93 percent. The number 57 stone was used as coarse aggregate and had an absorption capacity of 0.44 percent. The concrete exhibited an air content of 6.5 percent, a slump of 3 inches (76 mm), and a 28-day compressive strength of 5,100 psi (35 MPa).

UHPC Overlay

The UHPC overlay material was commercially available and was designed to be thixotropic. Thixotropy is a property that makes the material less viscous when subjected to mechanical agitation. The solid components, except the steel fibers, of the UHPC were supplied as a preblended and prebagged powder that included cementitious materials and inert fillers. The supplier also provided one liquid chemical admixture, likely a superplasticizer. The UHPC was dosed with 3.25 percent of steel microfiber reinforcement by volume. The material exhibited a 5-inch (127-mm) static flow and a 7-inch (178-mm) dynamic flow after 20 drops, per ASTM C1437 (ASTM 2020b). Lastly, the UHPC overlay material had a mature compressive strength greater than 18,000 psi (124 MPa).

LMC Overlay

An LMC overlay mix design was based on a common bridge deck concrete overlay mixture used in the State of Virginia. LMC was based on VDOT specifications (VDOT 2016). The reactive component of the mixture included type I/II portland cement. The concrete was designed to have a w/cm of 0.38 and fine and coarse aggregate contents of 39 percent and 29 percent by volume, respectively. Fine aggregates had an absorption capacity of 0.93 percent. The number 8 stone was used as coarse aggregate and had an absorption capacity of 0.49 percent. A commercially available latex admixture was included in the concrete at a dosage of 30 percent by weight of cement. The LMC exhibited an air content of 6.5 percent, a slump of 4 inches (102 mm), and a 28-day compressive strength of 6,500 psi (45 MPa).

Specimen Details

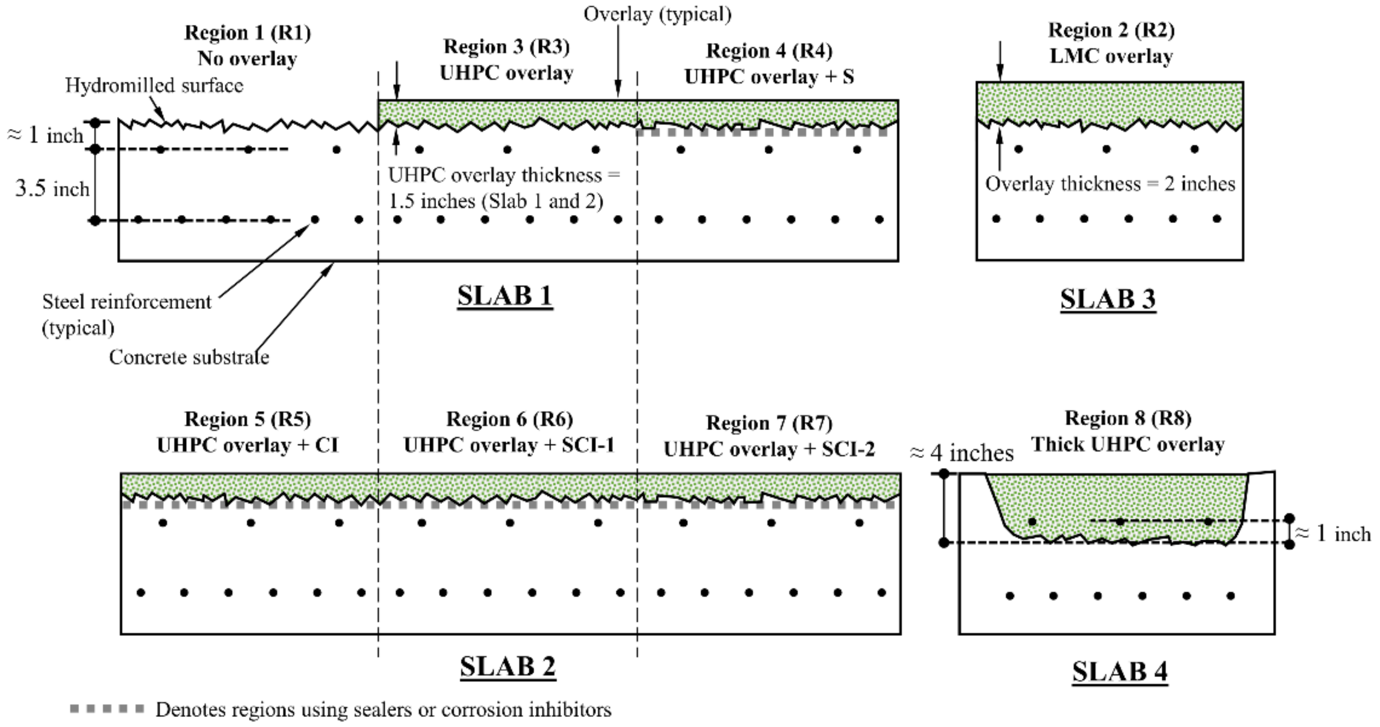
Four concrete slabs were used as substrates in this study. Figure 1 shows a schematic of these substrate slabs. Slabs 1 and 2 had multiple test regions, whereas slabs 3 and 4 only had a single test region. The area of each test region measured 24-inches (610-mm) wide and 24-inches (610-mm) long. The layout and spacing of the reinforcing rebars aligned with that described in the ASTM G109 test method, where one bar was installed 1 inch (25 mm) below the top surface of the concrete, and two other bars were installed 3.5 inches (90 mm) below the top bar (center to center) (ASTM 2013).

Specimen Preparation

Prior to constructing the concrete substrate slabs and casting concrete, the rebars were immersed for 7 days in a supersaturated sodium chloride solution until significant visible corrosion was observed on the surface of the bars. This step was taken to simulate corrosion that may be found in a highway bridge deck reinforcement. At the time of installation, only 8 inches (203 mm) of steel were exposed in the concrete after wrapping both ends of the rebar with electroplaters tape and coating the taped ends with epoxy.

To simulate the conditions that may be found in an in-service bridge deck exposed to deicing salts, sodium chloride was added into the mixing water prior to the concrete-mixing process. Four pounds (2.4 kg/m^3) of sodium chloride were added per cubic yard of concrete. This addition resulted in a chloride content of

Figure 1. Illustration. Schematic of the concrete substrate slabs and test regions.



Source FHWA.
Note: 1 inch = 25.4 mm.

approximately 900 ppm, which is commensurate with what might be found in the field at the reinforcement level. This chloride level was based on findings from a recent project bridge deck overlay project in the U.S. northeast. After casting concrete, the slabs were cured under laboratory environmental conditions of 73°F (23°C) and 50-percent relative humidity for 28 days. After that, a 3-percent sodium chloride solution was ponded on the top surface of the slabs for a period of 3 mo to promote a continuous corrosion process, as seen in figure 2.

Generally, on overlay installation projects, the deck surface requires preparation and roughening prior to the installation of the overlay to remove poor-quality concrete and promote bonding between the substrate concrete and the overlay. In this study, the concrete surfaces were prepared using hydromilling completed by a regional hydromilling contractor. Hydromilling is a popular deck preparation method in overlay applications because it has a low risk of inducing microcracking to the concrete substrate (International Concrete Repair Institute 2013). Figure 3 depicts the concrete substrate after hydromilling. This surface had an International Concrete Repair Institute surface roughness value greater than 10 and had significant micro and macrotexture, as seen in figure 3. The concrete slabs were then maintained in laboratory conditions for an additional 2 mo before the overlay materials were applied. A 3-percent sodium chloride solution was ponded on the top surface of the slabs during this 2-mo period.

Test Matrix

Eight different overlay cases (regions (R)) were evaluated in this study, as shown in table 1.

Figure 2. Photograph. Specimen undergoing chloride ponding, with solution being held in place by a foam dam.

Source: FHWA.

Figure 3. Photograph. Concrete substrate after hydromilling.

Source: FHWA.

Table 1. Test matrix parameters.

Sample Region	Slab	Overlay Type	Overlay Thickness	Sealer/CorrosionInhibitor Used[a]	Bond Testing
R1 (control)	1	None	N/A	N/A	No
R2	3	LMC	2 inch (51 mm)	None	Yes
R3	1	UHPC	1.5 inch (38 mm)	None	Yes
R4	1	UHPC	1.5 inch (38 mm)	S	Yes
R5	2	UHPC	1.5 inch (38 mm)	CI	Yes
R6	2	UHPC	1.5 inch (38 mm)	SCI-1	Yes
R7	2	UHPC	1.5 inch (38 mm)	SCI-2	Yes
R8[b]	4	UHPC	≈ 4 inch (102 mm)	None	No

Note: N/A = not applicable; [a] = prior to applying these chemicals, substrate concrete surfaces were kept clean, dry, and free of laitance; [b] = reinforcing bars were cleaned prior to the installation of the overlay using a steel wire brush.

Each region consisted of three reinforcing bars in which the corrosion rate was evaluated over approximately 2 years (110 weeks) using the technique described in the next section. During the 110-week corrosion testing period, the top of each specimen was ponded every 2 weeks with a 3 percent sodium chloride solution to promote an accelerated continuous corrosion process. All the specimens were kept in laboratory environmental conditions of 73°F (23°C) and a 50-percent relative humidity throughout the testing period.

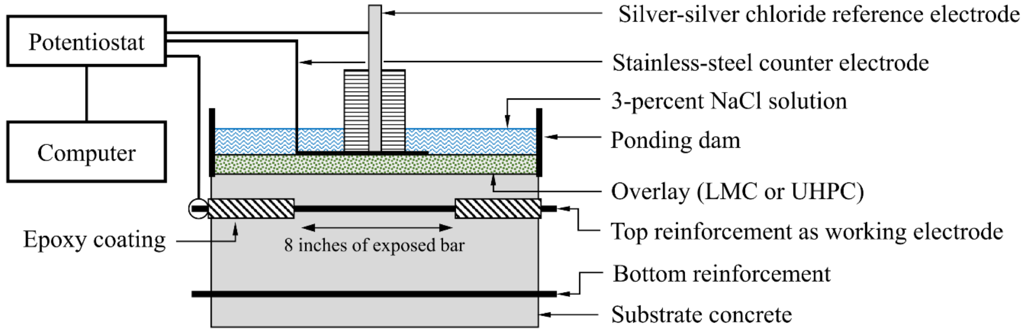
Test Methods

Corrosion Rate

Cyclic polarization testing was performed to determine the corrosion rate of the steel reinforcement of the concrete slabs, following a method similar to ASTM G61; however, due to the aggressive nature of the test method, testing was only performed two times over the 2-year chloride ponding period (ASTM 2018). Testing was performed during the wet chloride ponding cycle of those weeks. Cyclic polarization is a technique that provides information about a material's (i.e., alloy) corrosion rate and its potential for and susceptibility to pitting corrosion placed in a particular environment (Poursaee 2009). To conduct the test, a current is applied through the metallic material of interest, and the response of the material is monitored at a constant scan rate of 2 mV/s until the end of the testing cycle.

Cyclic polarization testing was performed at 75 and 110 weeks after the placement of the overlay materials. A potentiostat was used to measure the corrosion potential of the rebar. This metric served as a reference point to shift the potential of the rebars for evaluating the corrosion rates. The potentiostat automatically estimates the corrosion rate of the steel rebar based on Faraday's law (Andrade and Alonso 1996). Figure 4 shows a schematic of the test configuration, and table 2 provides details related to the testing parameters. The lower scan rate of 2 mV/s was selected due to the rebars being subjected to a corrosive environment prior to placement in the concrete (Poursaee 2009).

Figure 4. Schematic. Schematic representation of cyclic polarization test.



Source FHWA.
Note: NaCl = sodium chloride.

Table 2. Cyclic polarization test parameters.

Test Parameters	Values	Units
Initial voltage versus Eoc	−0.01	Volts
Apex voltage versus Eoc	1	Volts
Final voltage versus Eoc	−0.1	Volts
Forward scan rate	2	Millivolts/second
Reverse scan rate	2	Millivolts/second
Sample period	1	Seconds
Apex current	0.006 (1)	Milliamperes/inch^2 (milliamperes/centimeter^2)
Exposed rebar surface area	12.57 (81.07)	Inches^2 (centimeters^2)
Density of steel	0.28 (7.87)	Pounds/inch^3 (grams/centimeter^3)
Equivalent weight	0.06 (27.92)	Pounds (grams)

Interface Bond Testing

A direct tension pull-off bond strength test was performed in accordance with ASTM C1583, commonly used to evaluate the bond between overlays and substrates (ASTM 2020c). Bond testing was performed on all test regions except for R1 and R8. The pull-off tests were performed after the 2-year ponding period to evaluate the effect that some of these corrosion-inhibiting chemicals (sealers and corrosion inhibitors) may have on the overlay-concrete bond strength. Test sample locations were prepared by gluing a 2-inch- (51-mm) diameter steel disc to the overlay. Once the adhesive was cured, a core was drilled through the overlay such that it penetrated 1 inch (25 mm) into the concrete substrate. Testing was then completed using a specialized pull-off bond testing device. Load was applied at a rate of 5 ± 2 psi/s (0.035 MPa/s) until failure. The failure load and the failure mode were recorded upon completion of the test. Three pull-off tests were performed per test region (R2–R7).

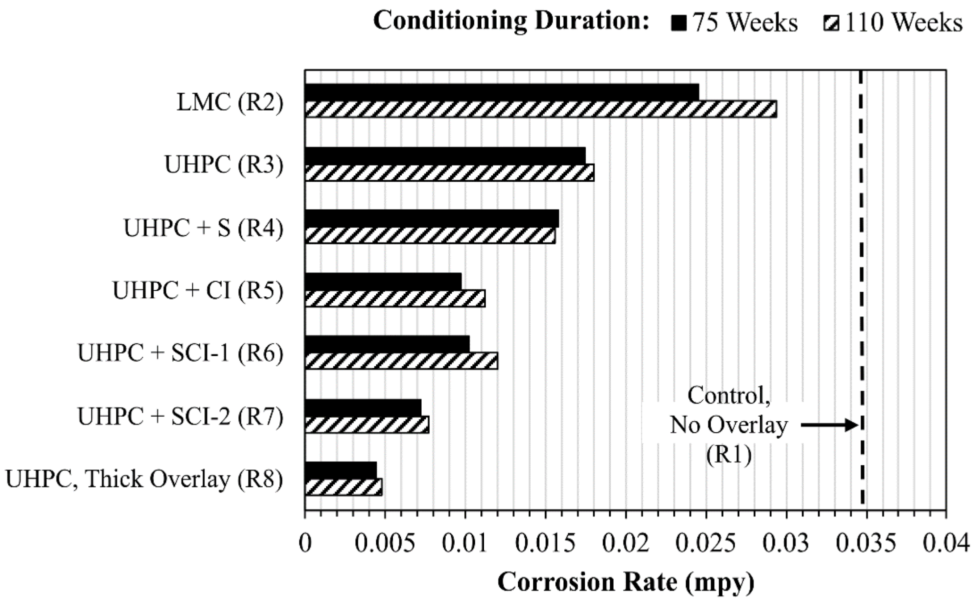
TEST RESULTS AND DISCUSSION

Corrosion Rates

Results from corrosion rate testing are shown in figure 5. The vertical dashed line denotes the corrosion rate for the control region (R1), which did not have an overlay. The dashed line was determined by taking the average of the corrosion rate at 75 and 110 weeks of conditioning, which was used as a reference for comparison purposes since it exhibited the highest corrosion rate compared to all the other cases. These results were expected because the control region was subjected to more diffusion of moisture, oxygen, and chlorides into the concrete substrate compared with the test regions (R2–R8) that employed overlays and/or sealers and corrosion inhibitors. In the latter cases, the combination of the overlay and corrosion-inhibiting techniques were expected to provide enhanced protection from contaminants. The level of protection is dependent on the thickness and permeability of the overlay material and the performance of the corrosion-inhibiting chemicals. As such, test regions employing LMC (R2) and UHPC (R3) overlays, without corrosion-inhibiting chemicals, exhibited average corrosion rate reductions of 20 percent and 50 percent, respectively, compared to the control region (R1). The LMC overlay was slightly thicker than UHPC overlay but has a coarser microstructure and thus a greater permeability, which explains the higher corrosion rate compared to the test region with the UHPC overlay.

R4 through R7 all employed UHPC overlays and sealers, corrosion inhibitors, or hybrid products. Each of these cases exhibited a reduced corrosion rate compared to R3, which only employed a UHPC overlay. In comparison with R3, the average corrosion rates of R4 (S), R5 (CI), R6 (SCI-1), and R7 (SCI-2) were reduced by 12 percent, 41 percent, 37 percent, and 58 percent, respectively. The differences in performance among

Figure 5. Bar graph. Measured corrosion rates.



Source FHWA.
Note: mpy = mils (thousandths of an inch) per year.

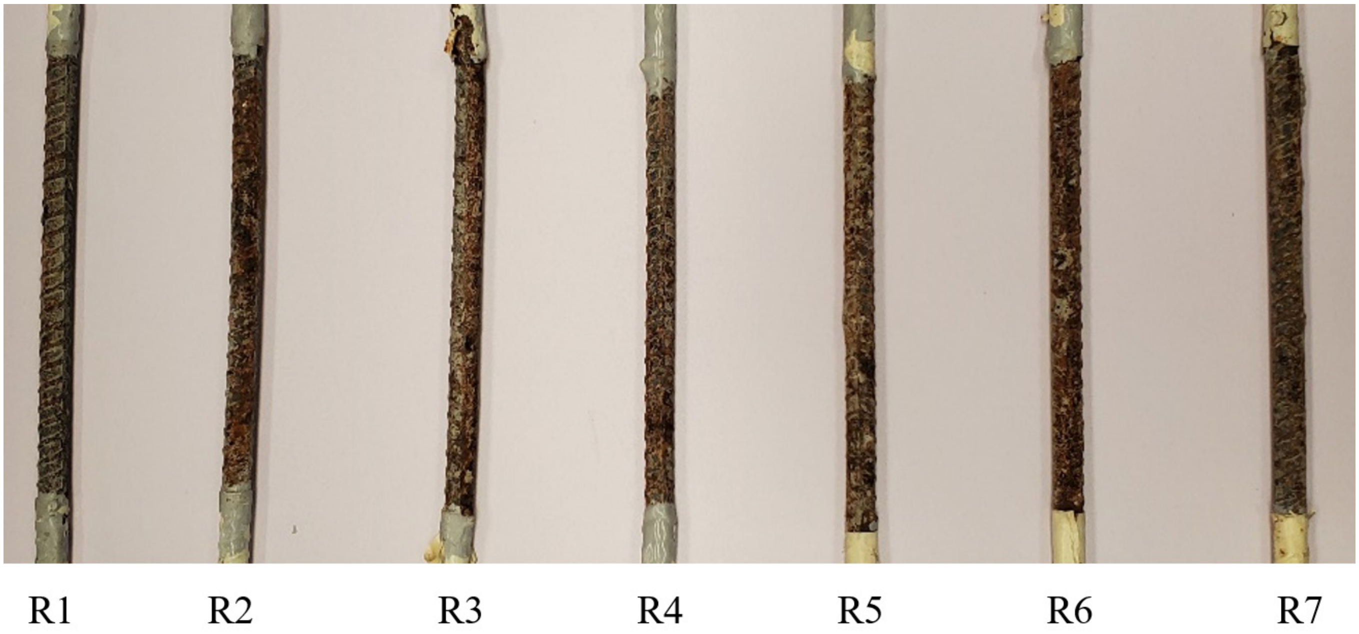
sealers and corrosion inhibitors can be attributed to the different compositions of the products.

Lastly, R8, which was prepared by excavating the concrete around the reinforcement and cleaning off the corrosion products prior to placing the UHPC overlay, exhibited the lowest measured corrosion rate (an 87-percent average reduction with respect to the control region (R1). Notably, all of the average corrosion rates measured in this study are considered negligible, as defined in RILEM TC-154, and can be attributed to general corrosion occurring on the surface of the metal (RILEM TC 154-EMC 2004). These findings were confirmed by extracting the rebars from all regions at the end of the testing period. (See figure 6.)

Bond Testing

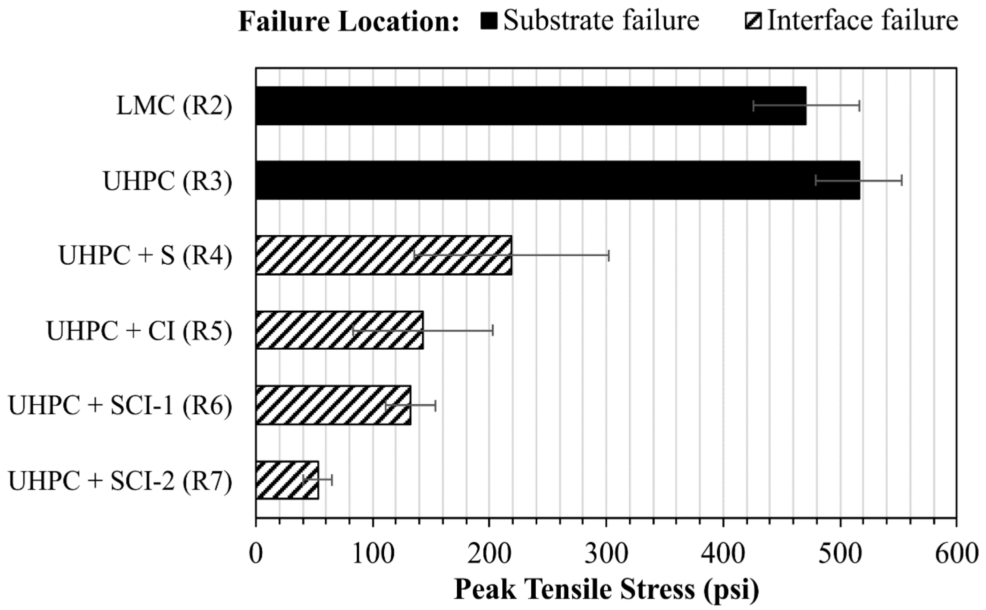
Direct tension bond test results are shown in figure 7 for R2 through R7. As noted, tests were completed after 2 years. The data reflect the average of four samples, and the error bars depict plus or minus one standard deviation. The LMC (R2) and UHPC (R3) overlays exhibited failure in the concrete substrate, indicative of a strong bond between the overlay materials and the substrate concrete. The average bond strength of test regions employing UHPC overlays and corrosion-inhibiting chemicals (R4–R7) all exhibited lower bond strengths than the respective regions that did not employ these products. Furthermore, in each of these cases, failure occurred at the overlay-concrete interface. These results align with previous research conducted by VDOT that concluded applying corrosion inhibitors prior to the placement of the overlay will negatively affect the bond performance of the overlay system (Sprinkel 2003). This study hypothesized that the corrosion-inhibiting chemicals will act as a potential bond breaker. Additionally, bond strength in the presence of corrosion-inhibiting chemicals may have a time-dependency or exposure-dependency component. Figure 8 compares two sets of bond test data obtained at the Turner-Fairbank Highway Research Center (TFHRC): One set collected 7 days after the placement of the overlay (shown in figure 7) and another set collected after 2 years of ponding with salt and undergoing corrosion. Bond tests conducted after 7 days indicate minimal impact with the introduction of corrosion-inhibiting chemicals, while results from testing undergoing 2 years of chloride ponding indicate a reduction in bond strength. These results demonstrate the potential of a time-dependency or exposure-dependency component to bond strength when corrosion-inhibiting chemicals are installed or

Figure 6. Photograph. Bars extracted from regions R1–R7 after 110 weeks of conditioning.



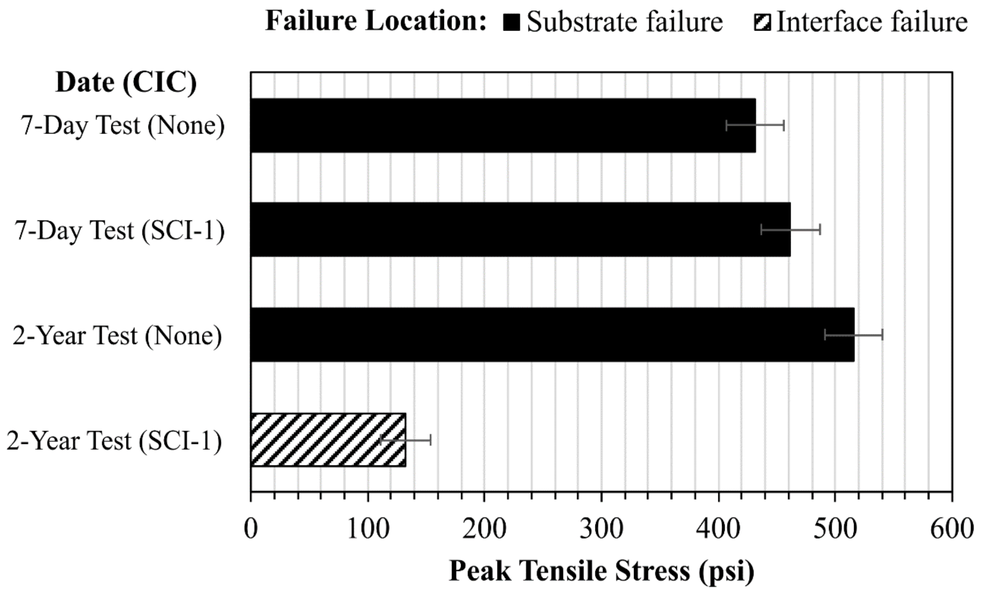
Source: FHWA. Note: 1 inch = 25.4 mm.

Figure 7. Bar graph. Pull-off bond results for tests completed after 2 years of conditioning.



Source: FHWA.

Figure 8. Bar graph. Early versus later age pull-off bond test results.



CIC = corrosion inhibiting chemical.

Source: FHWA.

applied prior to the placement of the overlay. Further research is needed to better understand this potential negative effect of sealers and corrosion inhibitors at later ages and after chloride and moisture exposure.

CONCLUSIONS

This TechNote summarizes the recent study conducted by TFHRC researchers to evaluate available techniques to inhibit existing corrosion of bridge deck reinforcement prior to an overlay application. A commercially available UHPC overlay material was tested with and without common corrosion-inhibiting chemicals, such as sealers and corrosion inhibitors. The corrosion-inhibiting chemicals were applied directly to the prepared concrete substrate prior to the placement of the UHPC overlays. The data were collected for a conventional LMC overlay as well. The corrosion activity was monitored using corrosion rate measurements, and bond testing was completed at the end of the corrosion rate testing period. The following conclusions can be made:

- The use of an LMC or a UHPC overlay reduced average corrosion rates by 20 percent and 50 percent, respectively, when compared to a control test case that did not employ an overlay. The reduction in the corrosion rates was attributed to the additional protective layer (i.e., the overlay), which prevented external chlorides, moisture, and oxygen from penetrating the concrete and further corroding the reinforcement.
- The use of sealers, corrosion inhibitors, or hybrid products in combination with a UHPC overlay further reduced the rate of corrosion. The percentage for which the rate of corrosion was reduced depended on the type of sealer/corrosion inhibitor used. As a result, these corrosion-inhibiting chemicals further reduced corrosion rates by as much as 45 percent when compared to the region with only a UHPC overlay.
- The best performing test case was R8. In this case, substrate concrete around the reinforcement was removed by hydromilling, and the corrosion products around the reinforcement were removed prior to placing the UHPC overlay. R8 exhibited an 87 percent average reduction in the rate of corrosion compared to the control region (R1). This result was likely due to the removal of existing chlorides in the substrate concrete.
- Despite their good performance in reducing the rate of corrosion, the long-term presence of sealers and corrosion inhibitors had a clear negative impact on the overlay to concrete bond strength at a late testing age. Bond strength was reduced by as much as 80 percent, depending on the type of corrosion-inhibiting chemicals applied prior to overlay installation. More research is needed to better understand this negative effect at later ages, since it was not observed with one of the products used in the study at early ages.

RECOMMENDATIONS

Since this research focused more on UHPC overlays used in conjunction with corrosion inhibiting chemicals, the recommendation provided only covers UHPC overlays, not LMC overlays. The reader should refer to previous research for recommendations related to the use of corrosion-inhibiting chemicals in conjunction with LMC overlays. The authors of this TechNote recommend the following:

- In cases where existing substrate concrete is removed but the top mat of reinforcing steel is not exposed: The application of sealers with or without corrosion inhibitors directly to the substrate concrete prior to the placement of the UHPC overlay is not needed unless specific long-term interface bond performance data are available for the engineer's review and consideration. Adequately designed UHPC overlays have very low permeability and do not require additional protection from moisture. However, if needed, sealers should be applied to the surface of the UHPC overlay.
- In cases where existing substrate concrete is removed and the top mat of reinforcing steel is exposed and cleaned: The application of sealers with or without corrosion inhibitors directly to the substrate concrete prior to the placement of the UHPC overlay is not recommended. The corrosion potential will be greatly reduced if UHPC fully encapsulates the top mat of steel that has been cleaned and the surrounding chloride laden substrate concrete has been removed.

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