Study Shows Potential to Extend the Installation Season for Latex-Modified Concrete Overlays

by Chuck Fifelski, Trinseo

Latex-modified concrete (LMC) can be found across the United States and is typically used to rehabilitate old and worn-out concrete bridge deck overlays, parking decks, and other roadway surfaces. Known for its quality performance, LMC offers lower maintenance and total costs over a bridge's expected lifetime when compared with other concrete repair alternatives. In fact, LMC overlays provide more than 25 years of maintenance-free service life to a bridge deck.[1]

Like most concrete systems, the installation period for LMC is restrained by ambient-temperature variations. The specifications of most state departments of transportation (DOTs) only allow LMC bridge deck overlays to be installed and cured within a temperature range of 50°F to 85°F.

To challenge this constraint, a new study conducted by Trinseo, GTS Consulting, and Concrete Strategies sought to determine whether LMC can be installed and cured at lower-temperature conditions without compromising performance.[2]

Low-Temperature Curing

Using an LMC mixture containing a proprietary concrete modifier, the study examined the development of compressive strength, bond strength by slant-shear test, and chloride-ion penetration resistance over a 6-month period when LMC is cured at controlled temperatures of 35°F, 40°F, 45°F, 50°F, and 72°F.

To test for performance properties, three sets of LMC cylinders were cast and cured at the targeted temperatures for 180 days. Performance metrics were measured at 2-, 5-, 28-, 90-, and 180-day intervals for each temperature.

For all temperature conditions, the compressive strength increased from 2 to 180 days, with the LMC that was cured under lower-temperature conditions exhibiting increasing strength development over time (**Fig. 1**). After 5 days of curing, all systems achieved the 3000-psi minimum requirement typical for most state DOTs for opening a roadway to traffic.

When bond strength by slant shear was tested, the results showed that bond strength for each cure temperature increased over the test period of 28 to 180 days (**Fig. 2**). Samples maintained at lower temperatures developed higher bond strength compared with higher-temperature systems at every testing interval. In fact, the samples maintained at 40°F had higher bond strength at 28- and 180-day intervals than the other temperature systems.

Testing showed that even when cured at low temperatures, LMC improves chloride-ion penetration resistance over time (**Fig. 3**). Samples cured at lower temperatures began in the moderate range of penetrability and decreased to the low-permeability range based on the chloride-ion penetrability ratings shown in **Table 1**. Chloride-ion penetration resistance improves over time due to polymer coalescence and film formation; therefore, low-temperature curing is not expected to negatively affect the chloride-ion penetration resistance performance of LMC.

Conclusion

Overall, when LMC overlays are installed in lower-temperature curing conditions as compared with the temperature ranges in most existing DOT specifications, LMC develops excellent compressive strength, delivers excellent bond-strength performance, and generates expected chloride-ion penetration

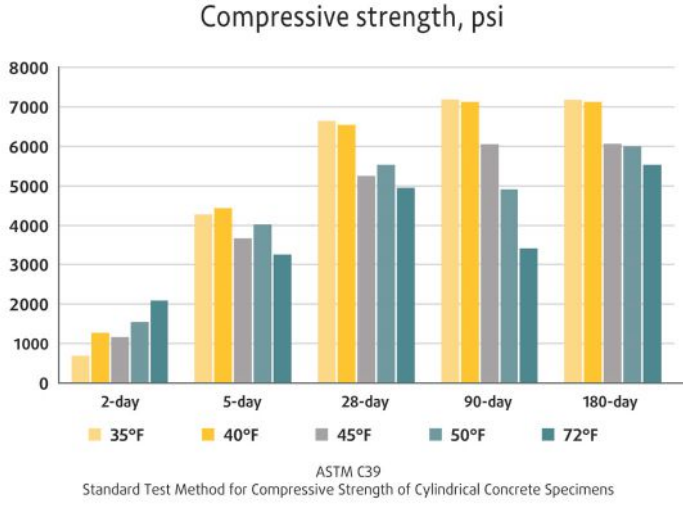

Figure 1. Compressive strength of latex-modified concrete cured under various temperature conditions. All Figures and Tables: Trinseo.[2]

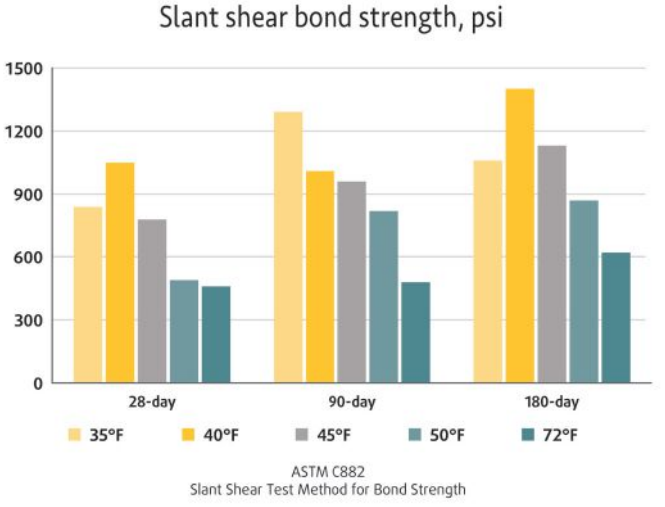

Figure 2. Slant shear bond strength for latex-modified concrete cured under various temperature conditions.

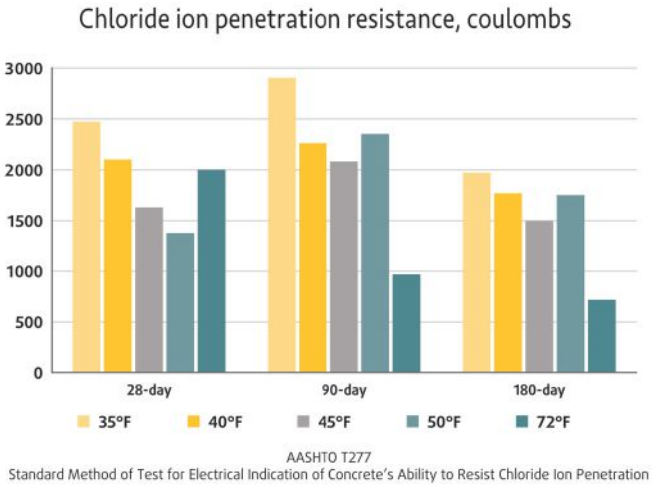

Figure 3. Rapid chloride-ion permeability test results for latex-modified concrete cured under various temperature conditions.

resistance. Thus, DOTs should reexamine temperature specifications and consider allowing the placement of LMC overlays in lower-temperature conditions, which would expand the installation season.

Table 1. Chloride-ion penetrability ratings

Charge passed, coulomb	Chloride-ion penetrability
> 4000	High
2000–4000	Moderate
1000–2000	Low
100–1000	Very low
< 100	Negligible

References

1. Liberati, E. 2020. *Rapid Set Concrete Bridge Deck Overlays*. Miami, FL: Accelerated Bridge Construction University Transportation Center at Florida International University. https://abc-utc.fiu.edu/wp-content/uploads/sites/52/2020/01/paper-9-Rapid-Set-Concrete-Bridge-Deck-Overlays.pdf.
2. Trinseo. 2022. "Report on Low Temperature Cure of Latex Modified Concrete." https://trinseo.widen.net/s/mbgrtqwj5d/2022_technical-report-on-low-temp-curing-of-lmc_final---pages.

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