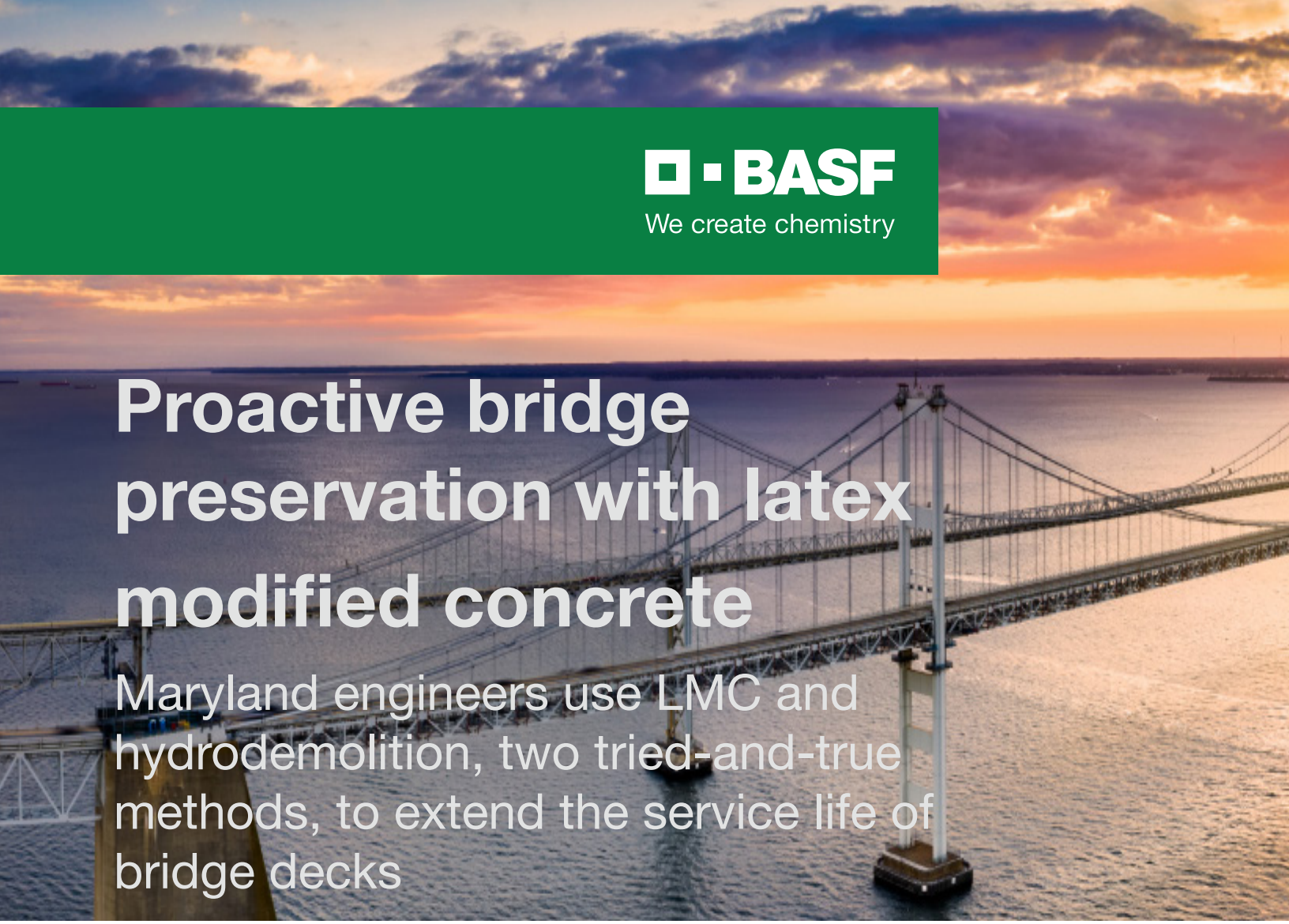

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Proactive bridge preservation with latex modified concrete

Maryland engineers use LMC and hydrodemolition, two tried-and-true methods, to extend the service life of bridge decks

When it comes to keeping the nation's bridges in great condition, experts recommend getting ahead of the game. A strategic bridge preservation program helps transportation agencies minimize costs and traffic disruptions.

That's how William Pines, Chief Engineer at the Maryland Transportation Authority (MDTA), prefers to tackle infrastructure preservation projects. He leads a team of more than 80 state employees in the construction and maintenance of highways, toll roads, tunnels and bridges.

"Our agency has a very proactive approach to preserving our infrastructure," **says Pines.**

"We try to do preventative maintenance and preservation activities, number one, to [prolong] the service life of our structures as long as possible. Number two, we aim to get the best performance out of bridges throughout that service life."

The MDTA chooses latex modified concrete (LMC) for most bridge deck preservation projects. A mix of concrete and latex solids, LMC has been used as a bridge deck overlay treatment for more than 50 years.

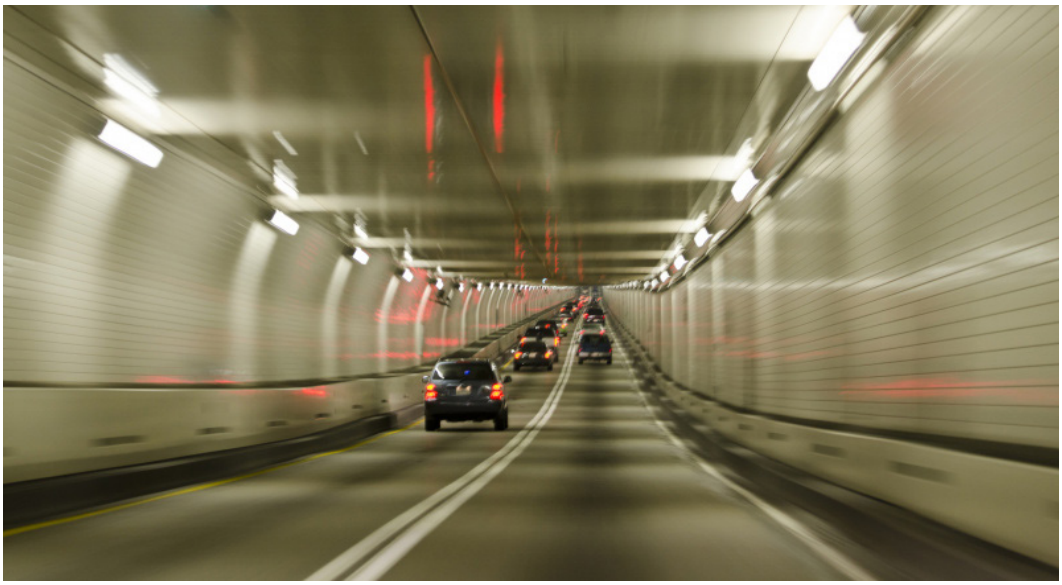
The extended lifespan of LMC keeps bridges in satisfactory condition longer compared to alternative overlay methods, which helps Pines and his team make the most of their budget, time and resources.

Keeping bridge decks in the rotation

With more than 200 active projects in the state's $2.8 -billion capital program, infrastructure maintenance is a careful balancing act. The MDTA oversees around 325 of the bridges in Maryland. Working with the Maryland Department of Transportation (MDOT), its parent agency, the MDTA owns high-profile bridges and tunnels such as the Chesapeake Bay Bridge, Fort McHenry Tunnel and Baltimore Harbor Tunnel.

To make that happen, the MDTA systematically assesses the condition of each structure under its purview, then categorizes construction, repair or restoration projects based on need.

That process starts with annual condition inspections on all structures. The agency then reviews ratings on the condition of a given bridge's paint, bridge deck, steel members and so on.



LMC surface inside the Baltimore Harbor Tunnel.

Pines' team works closely with engineering and construction consultants and contractors to meet the objectives outlined in each program. Their regular rotation of projects ensures the MDTA's assets don't drop below a specific condition rating.

"Our key approach in bridge preservation is to keep our assets in satisfactory condition throughout their life so that we can extend the service life as long as possible," says Pines.

"Generally, we do not let them decline to the point where we have assets in poor condition."

Some of the bridge work in the MDTA's capital program is necessary for functional purposes, such as lane expansions to accommodate more traffic. They take a multifaceted approach to enhance bridges for traffic, safety and system preservation.

All that data feeds into a bridge asset management system that allows Pines' team to analyze and make decisions about their structures.

"It gives us recommendations based on algorithms," Pines explains.

"But we don't like to rely on computers for everything. We have a manageable number of assets in good condition, so typically we go out and have a leadership team of state employees who look at our system holistically. Our inspectors give us element-level data through their lens of an individual bridge."

After the validation process, the asset management system provides estimates for preservation activities, which the team can program in to help forecast capital planning. The team works through all these steps to create a plan before they begin work on a bridge.

Updating a historic bridge with LMC

Using their multi-pronged assessment system, the MDTA recently scheduled the Chesapeake Bay Bridge for a replacement of the bridge deck overlay. The program identified a need to restore a long stretch of the westbound section of the driving surface of the bridge.

The deck study included non-destructive testing (NDT) to observe the level of delamination in the deck surface. Inspectors then took corings of the deck to validate the NDT findings and identify chloride levels, which helped them determine the extent of deterioration under the existing overlay system and the ability for a new overlay to bond properly to the substrate.

"That program helped us confirm that a replacement of the existing overlay with LMC was appropriate as a repair option," **Pines explains.**

"So that's exactly what we implemented."

For the MDTA, the choice to use LMC was natural. The state of Maryland has used LMC overlays for many years, and its use and installation procedures are outlined within the state's standard specifications.

"We've used LMC overlays on a number of other projects," **says Pines.**

"Some of our sister transportation business units, like MDOT State Highway Administration, also use LMCs regularly."

The method was already tested on the Chesapeake Bay Bridge, which first opened in 1952 and spans more than 4.3 miles. A micro-silica overlay was installed in the early 2000s and, for a combination of reasons, failures occurred on the bridge's left and center lanes.

Within the next three years, the bridge deck surfacing in those two lanes would be replaced with LMC, but the right lane remained in working condition.

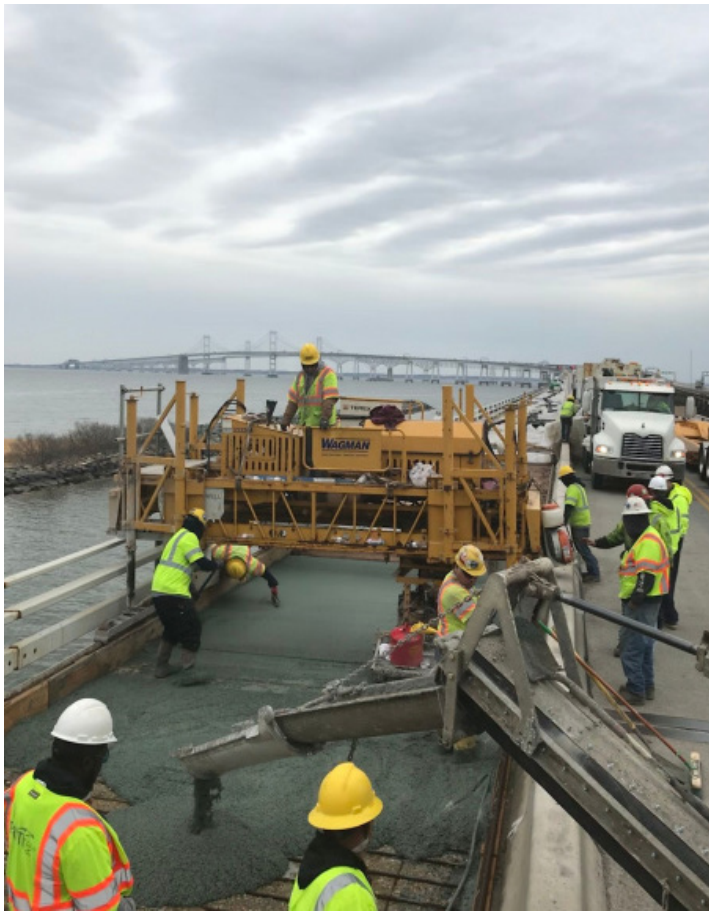
Last year, the right lane became due for an update of its own, and Pines' team undertook the job. They took lessons learned from the previous projects to restore the right lane to a satisfactory condition.

"We addressed a lingering issue from the history of that prior overlay," **Pines says.**

"We had a lot of confidence going into the right lane project that an LMC was a good fit for this bridge – it had been done before, and it was holding up well."

Because it was confined to the right lane, the project replaced roughly 19 percent of the Chesapeake Bay Bridge's total wearing surface area. Pines expects an added service life of about 25 years from the LMC overlay.

"We wanted to make sure we were doing proven, tried-and-true things that prevent failures and get the service life we wanted."



Contractor placing LMC on the Chesapeake Bay Bridge.

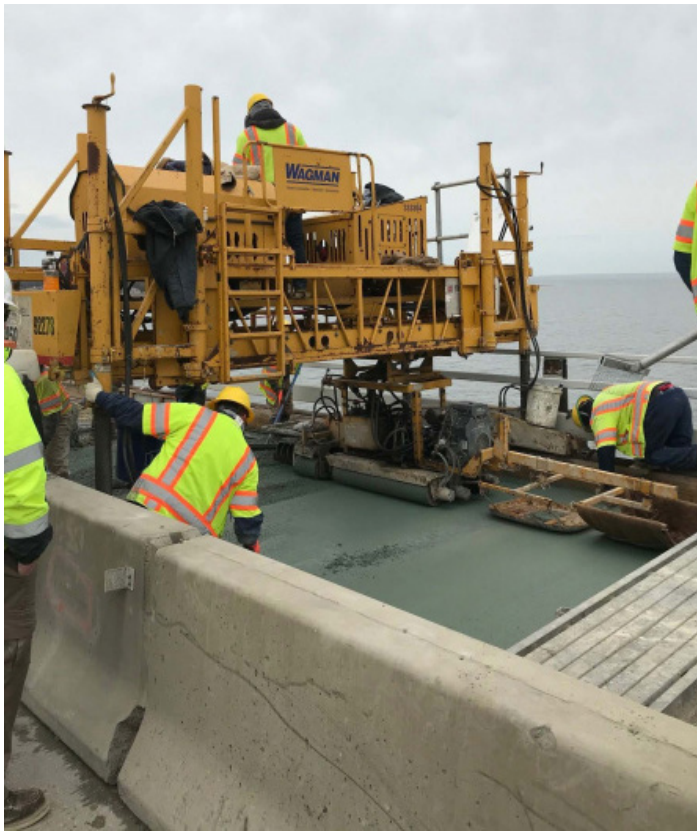
Rising to the Chesapeake Bay Bridge challenge

With latex modified concrete, as with any overlay, surface preparation is key to achieving a strong bond. MDTA's engineers found LMC bonds best when paired with a concrete removal technique called total surface selective removal hydrodemolition.

They first use a mechanical milling machine to grind off the bridge deck surface to a constant depth. Then total surface selective removal hydrodemolition comes in to remove any defective concrete at a fixed pressure. This takes out all the defective concrete to whatever depth is necessary, until it encounters sound concrete again.

"It really makes sure the LMC is bonding to a substrate of sound concrete," **says Pines.**

"Hydrodemolition also creates a very nice profile in the substrate. It creates a lot of surface area with a roughened surface – deeper pockets that will get you a very good bond."



Finishing operation on the Chesapeake Bay Bridge.

This form of surface preparation gives his team the greatest assurance they will clear out the defective concrete, create a strong bond with the overlay, and get the expected service life from the bridge deck.

Total surface selective removal hydrodemolition and LMC did require lane closures, which presented a challenge for the Chesapeake Bay Bridge restoration project. The state sees its worst traffic conditions in the middle of summer, which also tends to be the best time of year for construction.

"On the Chesapeake Bay bridge, we start to have severe congestion problems developing in mid-April and lasting all the way until mid-October," **Pines explains.**

"For this project, we really had to thread the needle to fit in repairs at just the right timeframe to avoid severe summertime traffic disruptions."

Pines' team worked within an aggressive schedule to complete the work within the right temperatures, finding a small window in early fall to complete the project.

"We had to keep a significant portion of the bridge blocked off through the Thanksgiving and Black Friday period, so we worked with the local community to deal with the traffic impacts," **says Pines.**

"By working with them, we were able to finish that project more than a year ahead of schedule. It was a resounding success in terms of the project schedule and competitive bids."

He adds that the closures and work with the community were well worth the effort.

"If you're going to do a project of this magnitude, you get it right the first time so that you don't have to come back again in the near term."

The proof in the LMC pudding

After the latex modified concrete overlay was installed, the MDTA tested to ensure the overlay had bonded properly, checked for cracks in the concrete, then sealed any cracks they may have found.

"We try to have really good installation and curing processes to make sure we have a sound surface," he says.

"LMCs are great because their curing system creates an impermeable layer at the surface. That gives the surface a layer of protection you don't get with conventional concrete."

A typical latex used in LMC for bridge decking is BASF's STYROFAN® 1186. BASF developed STYROFAN 1186, a styrene-butadiene emulsion polymer, to improve concrete compressive and flexural strength, impermeability to oil and salt, and adhesion of new concrete to old. These characteristics all contribute to improved durability and result in a longer overall lifespan for the bridge deck.

Extended service life is the main draw of latex modified concrete, but agencies like the MDTA also benefit from materials that are well-known in the current market.

"We have a lot of contractors who can properly install LMC, and there's good competition for that kind of installation," he explains.

"Whereas there's limited experiences with some of the newer products out there, and so the bidding environment is an unknown for us."

The state of Maryland has installed LMC many times over the years, including one of the largest LMC installations in the country, just south of the Fort McHenry Tunnel. Pines says some of the MDTA's structures have had LMC overlays installed for decades with excellent performance.

"The market conditions are right for us to get a good installation out of the product. The service life is great, and the price has been favorable," he says.

"We always keep an eye out for new product developments, but we've had great experiences with LMC and plan to continue to use it in the future."

Next in line for MDTA

The future always holds more projects for the MDTA. Pines plans to continue coordinating with locals to ensure successful projects and minimal disruptions.

"The successes we've had working with the local community is something we're definitely going to leverage anytime a project requires lane closures," he says.

Based on the ongoing assessments of bridge deck installations in their state, the MDTA regularly sees metrics on system performance, and the data shows latex modified concrete continues to hold up well on bridges where it's been installed properly.

The agency plans to install more bridge deck overlays on the Fort McHenry Tunnel facility in the near future.

"We work very hard to keep our bridges in good shape and extend the service life as much as possible," Pines says.

"Leveraging a proactive approach to asset management is not always possible, but it's a big difference-maker with us."

“If you‘re going to do a project of this magnitude, you get it right the first time so that you don‘t have to come back again in the near term.”

William Pines
Chief Engineer at the MDTA

Contacts

United States and Canada
BASF Corporation
11501 Steele Creek Road
Charlotte, NC 28273
Phone: 800-251-0612
E-mail: dpsolutions@basf.com
Web: www.basf.us/dpsolutions

Mexico
BASF Mexicana, S.A. de C.V. Av.
Insurgentes Sur 975
Col. Ciudad de los Deportes 03710
Mexico, D.F.
Phone: 52-55-5325-2600
E-mail: contactoed@basf.com
Web: www.basf.com.mx

BASF Corporation, Charlotte, NC