MOUNTAIN-PLAINS CONSORTIUM

RESEARCH BRIEF | MPC 24-536 (project 663) | July 2024

Impact of Vehicle Fire on Polymer Concrete Bridge Deck Overlays

the ISSUE

The use of polymer concrete (PC), an overlay material on bridges and highways, is increasing because of its high bond strength, short curing times, good resistance to water and chlorine penetration, and excellent skid and abrasion resistance. However, the material is susceptible to degradation upon exposure to elevated temperatures such as those resulting from vehicle fires. Research is needed to characterize PC's behavior under such conditions and to propose remedies to limit the deterioration.

the RESEARCH

The research objectives are: 1) To identify the impact of vehicle fires on the performance of PC overlay; 2) To develop effective methods to improve the fire resistance of PC overlays. The research was planned and executed using a large composite slab, which consists of a conventional cement concrete substrate overlaid with polyester PC, designed according to the Utah Department of Transportation Structures Design & Detailing Manual to emulate a bridge deck section. Comprehensive pre-fire testing was carried out on this slab, employing both nondestructive and destructive methods to measure the PC overlay's baseline properties, including skid resistance, surface hardness, abrasion resistance, resistance to water and chloride penetration, bond strength, and presence of delamination. A simulated vehicle fire was then conducted on the large slab, replicating an accidental fire outbreak on a bridge deck with a PC overlay. This experiment was designed to mimic real-life conditions as closely as possible, including non-uniform heating and rapid cooling phases, which are typical in actual fire scenarios due to firefighting efforts. Temperatures recorded during the experiment reached up to 1,200°C within the vehicle and 745°C on the slab surface, providing a depiction of the severe thermal challenges PC overlays might face during a vehicle fire.

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A University Transportation Center sponsored by the U.S. Department of Transportation serving the Mountain-Plains Region. Consortium members:

Colorado State University
North Dakota State University
South Dakota State University
University of Colorado Denver
University of Denver
University of Utah
Utah State University
University of Wyoming

Lead Investigator(s)

Shuna Ni, PhD
shunani@umd.edu

Andrew D. Sorensen, PhD
adsorensen@tamu.edu

Co-Investigator(s)

David Unobe, PhD
DUnobe@schreiner.edu

Research Assistant(s)

Ashesh Pokhrel, GRA, MS

Project Title

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the **FINDINGS**

The findings indicated significant degradation in critical PC properties, including skid resistance, surface hardness, abrasion resistance, and resistance to water and chloride penetration. Notably, delamination of the overlay from the underlying concrete was observed, along with pronounced bond failures, particularly in areas that experienced the highest temperatures. As a remedy, this study suggested the application of an intumescent coating, which uses a blend of fire-retardant materials mixed into polyester binder resin, to cover the PC surface. Preliminary tests indicate that this method holds promise for mitigating the rapid deterioration of PC when exposed to elevated temperatures.

the **IMPACT**

This project developed an intumescent coating that can be applied directly to existing PC overlays with potential to significantly enhance the durability of existing PC overlays exposed to high temperatures.

For more information on this project, download the Main report at https://www.ugpti.org/resources/reports/details.php?id=1182

For more information or additional copies, visit the Web site at www.mountain-plains.org, call (701) 231-7767 or write to Mountain-Plains Consortium, Upper Great Plains Transportation Institute, North Dakota State University, Dept. 2880, PO Box 6050, Fargo, ND 58108-6050.

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