Research Brief

Wisconsin Highway Research Program
Project 0092-18-01
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Evaluation of Penetrating Sealers Applied to Saw Cut Faces in Concrete Pavement Joints

Research Objectives

- Evaluate the uniformity of sealer-application methods used on Wisconsin concrete pavement joints
- Determine the effectiveness of penetrating sealers in protecting concrete joints
- Develop standard specifications for applying penetrating sealers to concrete saw cuts

Research Benefits

- Demonstrated penetrating sealers' effectiveness in extending service life and improving performance of concrete pavement joints
- Affirmed the effectiveness of penetrating sealers in protecting bridge decks
- Provided guidance and specification updates on best practices in applying penetrating sealers

Principal Investigator

Danny Xiao
University of Wisconsin – Platteville
xiaoxi@uwplatt.edu

Project Manager

Kevin McMullen
Wisconsin Concrete Pavement Association
kmcmullen@wisconcrete.org

WisDOT Contact

Myungook Kang
myungook.kang@dot.wi.gov

Background

The biggest challenge to preserving concrete pavements in cold-weather climates is premature joint deterioration. The Wisconsin Department of Transportation (WisDOT) has applied sealers to the saw-cut faces of joints on several projects to reduce their susceptibility to damage and improve pavement performance; however, there has not yet been an investigation into the effectiveness and economy of the practice. The objectives of this study were to evaluate the uniformity of current sealer-application methods; determine the effectiveness of penetrating sealers in protecting concrete joints; and develop standard specification language for applying penetrating sealers to concrete pavement saw cuts.

Methodology

The research team conducted site visits to assess the performance of various sealers and sealer-application methods and rates on common Wisconsin concretes. Core samples were extracted from well- and poorly-performing joints and slabs at each site and tested for water absorption, contact angle and depth of penetration to evaluate the presence and effectiveness of sealers.

Additionally, concrete samples were produced and subjected to laboratory testing to determine the most effective sealer types, application methods and application rates. Based on these tests, sealers were applied to a section of highway and monitored for a year, after which core samples were taken and evaluated.

Results

Although there was no visual detection of the presence of sealers in in-service pavements (at two, six and eight years of service) previously treated with sealers, laboratory tests proved the presence and functionality through contact angle, absorption and penetration depth. Penetration depth ranged from 0.1" to 0.5", with an average of 0.2". Penetration depth correlated with concrete strength; less penetration was associated with high-performance concrete. Effectiveness decreased with years of service; however, joints with sealers still outperformed joints without sealers after more than eight years.

The laboratory study found that all penetrating sealers applied to concrete samples resulted in decreased absorption and extension of time to critical (85%) saturation; these results can extend pavement service life. Time to critical saturation in A-FA grade concrete was eight and a half times longer when silane was applied in dry conditions.

"This study reveals the potential benefit of applying penetrating sealer in concrete pavement joints at the time of construction. It is a cost-effective method to increase the durability of the joints. WisDOT will continue to apply the penetrating sealer to the saw-cut face to extend the service life of concrete pavement."
– Myungook Kang, WisDOT

Interested in finding out more?

Final report is available at:
WisDOT Research website

Treatment	Final Degree of Saturation	Days to 85% Saturation	Lifespan change
Untreated control	100%	23	-
40% silane applied after 7 days	64%	218	↑ 850%
40% silane applied 30 min. after sawing	82%	102	↑ 340%
10% siloxane mixture applied after 7 days	77%	150	↑ 550%
7% siloxane mixture applied after 7 days	84%	97	↑ 320%
SME-PS applied after 7 days	76%	148	↑ 540%
PAM applied 30 min. after sawing	100%	8	↓ 65%

Table 1. Time to Critical Saturation of Wisconsin A-FA Concrete Applied with Different Sealers

Core samples from the field study section were hydrophobic, with contact angle exceeding 90 degrees. There was no difference in time to critical saturation and no sign of sealer in the penetration depth test. The absence of sealer in the field study section was attributed to three possibilities: (a) very low permeability of high-performance concrete; (b) hydrophobicity of polished concrete after saw-cutting; and (c) difficulty in effectively covering vertical surfaces. Penetrating sealers may not function properly for low permeability concrete or be practicably applied sufficiently to a vertical surface.

Recommendations for implementation

The results of this study demonstrate how penetrating sealers can extend service life and improve performance of concrete pavement joints when properly applied. The research team made several recommendations for best practices and specification updates.

- Sealer should be applied after at least seven days of curing.
- Surfaces should be washed to remove saw slurry and allowed time to dry.
- Product should be applied directly to the interior of the sawed joint, with additional passes after 10 to 15 minutes to achieve proper coverage rate; multiple applications of sealer will further reduce absorption.
- Contractors should use the masonry block setup to test their sprayer system and application method to verify the uniformity of coverage.

Among the four products tested in this study, silane and Soy Methyl Ester-Polystyrene (SME-PS) were more effective than siloxane and lithium silicate. Application of penetrating sealer on joints of regular concrete is effective; however, it does not seem effective on joints in high-performance concrete due to the difficulty of sufficient coverage and penetration. This study also affirms previous studies showing penetrating sealers are effective in protecting bridge decks.

This brief summarizes Project 0092-18-01,
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