Tech Brief

U.S. Department of Transportation
Federal Highway Administration

PAVEMENT PRESERVATION HOW

The fourth round of Every Day Counts (EDC-4) innovations promoted quality construction and materials practices that apply to both flexible and rigid pavements. For flexible pavements, these include using improved specifications for thin asphalt surfacings such as chip seals, scrub seals, slurry seals, micro surfacing, and ultrathin bonded wearing courses; following improved construction practices; and using the right equipment to place these treatments. Rigid pavement treatments include the rapid retrofitting of dowel bars to reduce future faulting; the use of new, fast-setting partial- and full-depth patching materials to create a long-lasting surface; advanced pavement removal techniques to accelerate patching construction times; and advancements in diamond grinding that contribute to smoother and quieter pavement surfaces with enhanced friction.

BACKGROUND

Regional peer-to-peer exchanges between states were initiated to exchange knowledge on "How" to effectively implement pavement preservation. Adoption of a comprehensive pavement preservation program will ultimately result in an improved pavement condition and safety rating for the overall network, reduced agency and user delay costs, and decreased environmental impact. In order to achieve these objectives, an understanding of the concepts, capabilities, and applications relevant to constructing pavement preservation treatments with quality materials must be implemented via a technology program aimed at transportation agencies, contractors, consultants, and Federal Highway Administration (FHWA) staff.

PAVEMENT PRESERVATION HOW: NEW HAMPSHIRE, MASSACHUSETTS, MAINE, AND VERMONT

EDC-4 PEER-TO-PEER EXCHANGES

INTRODUCTION

On October 10th, 2018, an FHWA-sponsored EDC-4 "How" Pavement Preservation State Peer-to-Peer Exchange was conducted in Concord, New Hampshire, with four FHWA representatives; six department of transportation (DOT) representatives from New Hampshire, two from Massachusetts, three from Maine, and two from Vermont; and two local agency representatives. Larry Galehouse with the National Center for Pavement Preservation and Larry Scofield with the International Grooving & Grinding Association and American Concrete Pavement Association facilitated the day-and-a-half-long meeting. New Hampshire was the host state and provided meeting room facilities. Antonio Nieves of the FHWA provided the meeting background and kicked off the meeting.

The meeting format consisted of each of the states and local governments identifying their current procedures, issues, and successes for each of the topics discussed. Table 1 indicates the discussion topics.

Table 1. List of pavement preservation treatments discussed

Asphalt pavement preservation treatments	Concrete pavement preservation treatments
Asphalt rubber (AR) chip seal	Diamond grinding
Micro surfacing	Partial-depth repair
Hot in-place recycling (HIR)	Joint sealing
Chip seal	—
Cold in-place recycling (CIR)	—
Ultrathin bonded wearing course	—
Surface spray rejuvenators	—
Crack seal	—

SUMMARY OF IMPORTANT ISSUES OR SUCCESSES

Asphalt Concrete Pavement Preservation

Asphalt rubber (AR) chip sealing: Although three of the four states have used this treatment, only two states use it regularly, with one of these states having employed this treatment continuously since 2004 as part of its preservation program. The two states that use AR chip seals consider project selection very important and use the treatment on pavements in good condition. If there are cracks in the road, frost heave and rutting can become a problem.

A major advantage of an AR chip seal is that it can be swept immediately and opened to traffic very quickly. The state specifies at least a minimum of two pneumatic rollers are required, and it was noted that monitoring roller speed is important. One state achieves an 8- to 10-year service life from this treatment, and that is the preservation cycle the state uses for this treatment. The state also precoats its chips, which have a top size of ⅜ in. Additional chip seals or asphalt concrete (AC) overlays can be placed at a later date if needed.

The other state that regularly uses chip seals uses them primarily as a stress absorbing membrane interlayer (SAMI). Both states use the wet application process.

Aggressive snow plowing can be an issue for AR chip seals, and it is important to work with maintenance personnel to minimize winter damage. An additional issue for one of the states is that a bicycle board must approve the use of chip seals. See Table 2.

Micro surfacing: Although all four states have used this treatment, only two use it regularly. The two states that do not currently use this treatment instead use ultrathin overlays; politics appears to have played a role in this shift.

One of the states that does use the treatment just developed a new specification and is hoping to use micro surfacing more. It was recognized that surface preparation is critical, and CSS1-H tack coats are used for this purpose. CSS1-H emulsion is also used for the micro surfacing, and certified laboratories need to be used for the mix design. If the mix design is performed by a contractor's laboratory, third-party verification is required. A two-course micro surface is commonly used, with a total application rate of 30 to 32 lb/yd². The state does not recommend night work due to moisture issues and the potential for delamination. Training has been an issue due to limited experience with the treatment. See Table 3.

Hot in-place recycling (HIR): All four states have used this treatment successfully, but its use has been limited. The treatment costs less than a mill and fill option or a conventional overlay. In one state, the reduced cost of HIR compared to a conventional overlay allows the state to place a 1 in. thick overlay over the shoulders as well. It was discussed that it is important to use a good roadway template and reserve the treatment for roadways that do not have an excessive amount of crack sealant in the existing roadway. Previous bad experience with infrared heaters was noted, and their use, by State requirement, is no longer allowed in one state. Typical depths of milling are 1½ in., and projects are typically capped with an AC overlay after a cure period. See Table 4.

Table 2. Asphalt rubber chip sealing

State	Design		Material type				Construction procedures						
	Design procedure	Maximum ADT	Aggregate	Binder	Top size	P200	Aggregate rate	Binder rate	Rollers	Sweeping	Fog seal	Workforce	Pilot vehicle
New Hampshire	NA	NA	NA	PG58-28 with 18%–20% rubber	⅜ in.	Pre-coat chip	NA	NA	2 pneumatic	Prior to opening to traffic	NA	NA	Yes
Massachusetts	Wet process 30 mesh rubber	Lower volume roads	NA	15%–18% rubber	NA	NA	NA	0.5 gal/yd²	NA	NA	NA	NA	NA
Maine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vermont	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 3. Micro surfacing

State	Design method	Material type				Construction procedures						
		Aggregate	Binder	Type	Cement	Application rate	Crack seal in advance	Tack in advance	Sweeping in advance	Test section	Number of courses	Calibration verification
New Hampshire	Certified lab	NA	CSS-1H	2	NA	30–32 lb	Type 2 overband	Yes	Yes	NA	2	NA
Massachusetts	NA	NA	NA	NA	NA	NA	NA	Yes	NA	NA	NA	NA
Maine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vermont	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 4. Hot in-place recycling

State	HIR type	Construction procedures			
		Plant type		Minimum thickness	Minimum existing AC remaining
		Central	Roadway		
New Hampshire	NA	No	Yes	NA	NA
Massachusetts	NA	No	Yes	NA	NA
Maine	Full depth	No	Yes	1½ in.	NA
Vermont	NA	NA	NA	NA	NA

Chip sealing: Only one of the states uses this treatment as part of its preservation toolbox, though another state has used chip seals as a stress absorbing membrane. However, no state agency routinely uses this treatment. It was noted that the percentage of fines passing the number 200 sieve size is important. One state specification, by contract, requires that the percentage be a maximum of 2%, and the state penalizes contractors for exceeding that amount. Local agencies represented at the meeting successfully use chip seals. See Table 5.

Cold in-place recycling (CIR): Although all four states have had limited experience with this treatment, three of the four states consider it a good candidate for their preservation toolboxes. The treatment enhances competition with the hot-mix asphalt industry by providing an alternative treatment and thereby reduces preservation costs. A problem with previously placed crack sealants was discussed; these often become "sealant snakes" that can clog the CIR equipment.

Ultrathin bonded wearing course: This treatment is one of the more widely used pavement preservation treatments in this region. It is one of the states' workhorses and is used on high-volume roadways.

Some states prefer spray pavers for treatment application, but availability of this equipment in the northeastern US is limited. This scarcity of spray pavers causes some projects to be milled in advance and then left to wait to be overlaid for far too long. One state has initiated requirements specifying how long the milled surface can be trafficked until overlaid.

One state fills ruts using micro surfacing in advance of the ultrathin bonded wearing course to better control quantities. Two of the states do not require material transfer devices for placement. One state allows crack sealing (without routing) on the same project, but that state found that a harder base sealant is needed to keep the crack sealant from pulling out. This treatment does not lend itself to hand work, making ramps a little more difficult to overlay than other types of pavement. See Table 6.

Surface spray rejuvenators: Experience with rejuvenators in this region is limited to test sections or shoulder applications. Very little information exists about the long-term performance of this treatment in the region. It was noted that friction can be an issue and should be managed before the treated pavement is opened to traffic. One solution for overcoming this issue is to use a skid abrader before application of the rejuvenator. It was also noted that application of abrasives may also be necessary for friction management. Another concern raised regarding this treatment was how to determine whether a rejuvenator is effective; if it is found to be effective, how would this be accounted for in a pavement management system (PMS)? See Table 7.

Table 5. Chip sealing

State	Design		Material type				Construction procedures						
	Design procedure	Maximum ADT	Aggregate	Binder	Top size	P200	Aggregate rate	Binder rate	Rollers	Sweeping	Fog seal	Stripe pretreatment	Pilot vehicle
New Hampshire	NA	NA	NA	NA	NA	2%	NA	NA	NA	NA	NA	NA	NA
Massachusetts	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Maine	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vermont	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 6. Ultrathin bonded wearing course

State	Design method	Material type		Construction procedures				
		Aggregate type	Binder type	Crack seal in advance	Spray paver	Tack coat	Thickness	Used as interlayer
New Hampshire	NA	Type C	NA	NA	Yes	0.15 gal/yd^2	NA	NA
Massachusetts	NA	NA	NA	NA	NA	NA	NA	NA
Maine	NA	NA	NA	Yes	Yes	0.17–0.22 gal/yd^2	¾ in.	No
Vermont	See Table 407.03A	Type 2	Performance-graded asphalt binder shall be PG 70-28	Yes	Yes	Type A: 0.150 ± 0.025 gal/yd^2; Type B: 0.190 ± 0.025 gal/yd^2; Type C: 0.225 ± 0.025 gal/yd^2	Per engineer	NA

Table 7. Surface spray rejuvenators

State	Rejuvenator type	Traction abrasive used	Application rate	Agency or contractor applied
New Hampshire	NA	NA	NA	NA
Massachusetts	Reclamite and E5	NA	NA	NA
Maine	Bioproduct	Yes	NA	Contract
Vermont	NA	NA	NA	NA

Table 8. Crack sealing

State	Sealant type			Crack preparation			Installation procedures				
	Hot pour	Mastic	Other	Route cracks	Air blow cracks	Vacuum cracks	Temperature requirements	Overband	Flush fill	Detackifier	Workforce
New Hampshire	Type 2	Yes	NA	Yes	Yes	NA	Apply when ambient temperature is ≥50°F	Not allowed	Yes	NA	Contract
Massachusetts	ASTM D6690 Type II	NA	NA	NA	NA	NA	NA	NA	NA	NA	In-house
Maine	Yes	Yes	NA	No	NA	NA	NA	NA	NA	NA	Contract
Vermont	Type 4	NA	NA	Yes	Yes	NA	Apply when ambient temperature is at 40°F–104°F and when pavement temperature is at 50°F–140°F	Yes	NA	NA	NA

Crack sealing: This treatment is routinely used by all four states and is considered a necessary preservation treatment. Crack sealing is performed before most other preservation projects. The work is performed both by in-house forces and contractors. Typically, cracks 1/4 in. and wider are sealed. Hot-pour sealants installed in the overband configuration are the most common type of sealant used. Cracks are typically not routed, but for cracks as wide as 2 to 3 in. mastic might be used. One state does route cracks and uses a recessed sealant configuration. This state referred to a pooled-fund research project that indicated that routing is the best preparation treatment and that the overband sealant configuration is the best performing installation option. See Table 8.

Concrete Pavement Preservation

Diamond grinding: This treatment is rarely used in this region because of the very limited number of concrete pavements. Rather, asphalt overlays are the preferred treatment. Diamond grinding is only used as a corrective solution on new construction and bridge decks.

Partial-depth repair: This treatment is rarely used in this region because of the very limited number of concrete pavements. When repairs are needed, the states generally prefer to use full-depth repairs.

Joint sealing: This treatment is not used in this region because of the very limited number of concrete pavements.

KEY OBSERVATIONS

During this peer-to-peer exchange meeting, agency personnel representing four state and two local agencies identified and discussed their pavement preservation successes and challenges.

Preservation Successes

- On-call specialty contractors can provide an advantage in responding to preservation needs.
- Establishing preservation projects at the district level reduces administrative burdens for state agencies because such projects are not required to be included in the Statewide Transportation Improvement Plan (STIP). This also allows for the possibility of smaller planning windows.
- A crack sealing research project indicated that routing cracks is the best preparation treatment and that the overband sealant configuration performs the best.
- For AR chip seals, project selection is very important, and the treatment should only be applied to pavements in good condition. Otherwise, cracks in the pavement can result in frost heave and rutting.
- In-place recycling treatments enhance competition with the hot-mix asphalt industry by providing an alternative treatment and thereby reduce preservation costs.

Preservation Challenges

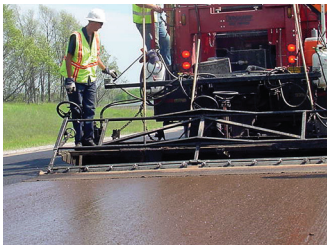
- It is difficult to program preservation treatments three to five years in advance.
- Aggressive snowplowing can be an issue for AR chip seals, and it is important to work with maintenance personnel to minimize winter damage.
- For in-place recycling treatments, an excessive amount of crack sealant in the existing pavement can be problematic.
- The availability of spray pavers in the northeastern US is limited. This scarcity of equipment can create issues on mill and fill projects where the milled surface is exposed to traffic for long periods, which generates roadway user complaints.

SUMMARY

Eight asphalt and three concrete pavement preservation treatments were discussed in depth (see Figures 1–11). While ultrathin bonded wearing courses and crack sealing are the predominate AC preservation treatments employed, all four states have used most of the treatments at some point. It was recognized that in-place recycling provides an opportunity to enhance competition with the hot-mix asphalt industry and thereby lower preservation costs. Concrete preservation treatments are not used in these four states due to the lack of concrete pavements and repair expertise. The states did not think an additional use of concrete pavements would enhance competition with the asphalt industry.

Charleston County, S.C.

Figure 1. Asphalt rubber chip sealing



National Center for Pavement Preservation

Figure 2. Micro surfacing

National Center for Pavement Preservation

Figure 3. Hot in-place recycling

Slurry Pavers, Inc.

Figure 4. Chip sealing

Pavement Recycling Systems

Figure 5. Cold in-place recycling

All States Materials Group

Figure 6. Ultrathin bonded wearing course

Pavetech Incorporated

Figure 7. Surface spray rejuvenators

National Center for Pavement Preservation

Figure 8. Crack sealing

International Grooving and Grinding Association

Figure 9. Diamond grinding

ACPA

Figure 10. Partial-depth repair

Dow Corning

Figure 11. Joint sealing

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CONTRACTING OFFICER'S REPRESENTATIVE
Antonio Nieves Torres
Construction Engineer
Federal Highway Administration
1200 New Jersey Ave. SE E73-446
Washington, D.C. 20590
202-366-4597 / Antonio.Nieves@dot.gov

AUTHORS
Larry Scofield, P.E.
American Concrete Pavement Association
9450 W Bryn Mawr Ave. Ste 150
Rosemont, IL 60018
lscofield@acpa.org

Jerod Gross, P.E.
Snyder & Associates, Inc.
2727 SW Snyder Boulevard
Ankeny, IA 50023
jgross@snyder-associates.com

DISTRIBUTION AND AVAILABILITY
This tech brief can be found at https://www.fhwa.dot.gov/pavement/preservation/.

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pavement, preservation, peer-to-peer

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AGENCY SPECIFICATIONS

The relevant agency specifications are available at the following websites:

New Hampshire: https://www.nh.gov/dot/org/projectdevelopment/highwaydesign/specifications/index.htm

Maine: https://www.maine.gov/mdot/contractors/publications/standardspec/

Massachusetts: https://www.mass.gov/lists/construction-specifications

Vermont: https://vtrans.vermont.gov/highway/construct-material/construct-services/pre-contractspecifications/2018

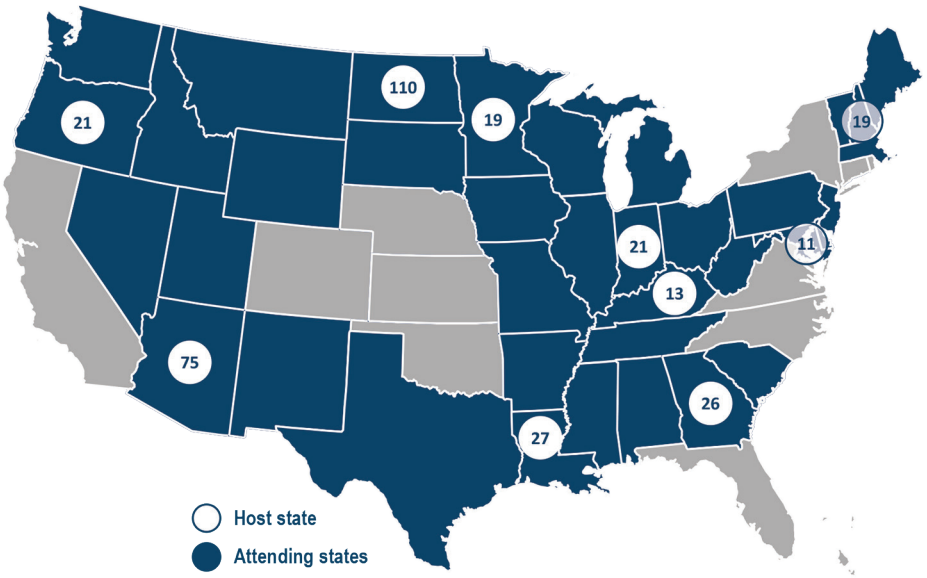
ONLINE RESOURCES

National Center for Pavement Preservation (https://www.pavementpreservation.org/)

National Concrete Pavement Technology Center (https://cptechcenter.org/)

Federal Highway Administration (https://www.fhwa.dot.gov/pavement/preservation/)

Pavement Preservation & Recycling Alliance (https://roadresource.org/)



Host state	AZ	DE	GA	IN	KY	LA	MN	NH	ND	OR
Attending states	NM	MD	AL	IL	TN	AR	IA	ME	MT	ID
	TX	NJ	SC	OH	WV	MS	MO	MA	SD	NV
	UT	PA	—	MI	—	—	WI	VT	WY	WA
Number of attendees	75	11	26	21	13	27	19	19	110	21

Regional state peer-to-peer exchanges were held in 10 states with 342 total attendees from 37 states