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: KENTUCKY, TENNESSEE, AND WEST VIRGINIA

EDC-4 PEER-TO-PEER EXCHANGES

INTRODUCTION

On September 25th, 2018, an FHWA-sponsored EDC-4 "How" Pavement Preservation State Peer-to-Peer Exchange was conducted in Lexington, Kentucky, with one FHWA representative and eight department of transportation (DOT) representatives from Kentucky, two from Tennessee, and two from West Virginia. 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. Kentucky was the host state and provided meeting room facilities. Larry Galehouse introduced the meeting background and kicked off the meeting.

The meeting format consisted of each of the states 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
Chip seal	Full-depth repair
Micro surfacing	Partial-depth repair
Cape seal	Dowel bar retrofit
Cold in-place recycling (CIR)	Joint sealing
Scrub seal	—
Crack seal	—
Rejuvenators	—

SUMMARY OF IMPORTANT ISSUES OR SUCCESS

Asphalt Concrete Pavement Preservation

Chip sealing: Two of the three states use chip seals as a preservation treatment, while one state only uses them as an interlayer or a component of a cape seal due to complaints when chip seals are used. All three agencies specify CRS-2P binder. Aggregate and binder application rates vary based on aggregate top size, which also varies. When used as a preservation treatment, breakdown rolling is accomplished by two pneumatic rollers and final rolling is accomplished with a static steel wheel roller. Chip seals are broomed before opening to traffic. In this region, problems with P200s have been an issue, with spec changes required to eliminate these problems. One state has a designated position to assist districts with training in field inspection and equipment calibration. Emphasis has also been placed on equipment certification. One agency has an internal group named the preventive maintenance alliance that meets twice a year and is working on improving treatment quality. Loss of experienced inspectors has been a continuing problem for all three states. Chip seals have been placed on roads with average daily traffic (ADT) of 11,000 vehicles per day. See Table 2.

Table 2. 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
Kentucky	NA	11,000	NA	CRS-2P	ASTM #9 (⅜ in.)	NA	16.5–18.5 lb/yd²	0.28 gal/yd²	2 pneumatic, then 5 tn steel wheel	Before opening to traffic	Yes	NA	NA
Tennessee	NA	NA	7, 78, 8, or 89	CRS-2P	¾ in.	NA	Depends on aggregate size (17–30 lb/yd²)	Depends on aggregate size (0.17-0.45 gal/yd²)	Initial self-propelled pneumatic tire roller followed by steel wheel	Power broom or approved	NA	NA	NA
West Virginia	Modified Kearby, McLeod, or other	None	3 blends	CRS-2P	12.5, 9.5, and 4.75 mm NMAS	<2%, with bonus/ penalty structure	See table 405.12.1 in spec	See table 405.12.1 in spec	Minimum of 2 pneumatic	After emulsion has cured	Yes	No	Not required

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
Kentucky	NA	Yes	Emulsified asphalt	Types 2 & 3	Type I	18 ± 2 lb/yd² (rut & leveling course) 24 ± 2 lb/yd² (surface course)	NA	0.03–0.06 gal/yd² before rut & leveling course only	Surface clean/free of debris	Single lane & 1000 ft	2	Yes
Tennessee	Mix design by qualified lab	Yes	Emulsified asphalt	CQS-1hP	Portland cement	<⅛ above rut (rut course) 14 ± 2 lb/ yd² (leveling course) 18 ± 1 lb/yd² (surface course)	NA	0.1–0.15 gal/yd²	Brooming, high pressure wash, compressed air, or approved	NA	1 & 2	Yes, but no state verification
West Virginia	Mix design by qualified lab, mostly ISSA test methods	Yes, two gradations	CSS-1hM or CQS-1hM emulsion via AASHTO M 316	2FA and 3FA (Types 2 and 3)	Type I portland cement, meets ASTM D 242	Single course: minimum 20 lb/ yd², Multiple course: 30 lb/ yd² total with final at least 16 lb/yd²	Not required by spec, but if it occurs, spec requires 14 days before placement of micro surfacing	Yes, emulsion diluted 1:3 and sprayed at rate of 0.05–0.12 gal/yd²	Thoroughly cleaned of loose material, vegetation, dirt, dust, and mud	Yes, 500 ft	1 & 2	Yes

Micro surfacing: All three states use this treatment. One state bids this treatment as an alternative to hot-mix asphalt (HMA) and warm-mix asphalt. Both single- and double-course applications are used. It appears that contractor availability and pricing are impacted by the bid letting dates, so one state begins letting contracts in December to improve opportunities. It was noted that without consistent work, it was difficult for contractors to maintain a trained workforce, leading to inconsistent construction quality and other problems. Agency training was also cited as a problem. Participants stated that very few people want to sit through training and webinars. Instead, everyone wants hands-on training with equipment. An example of good training is the open-house approach used by Asphalt Recycling & Reclaiming Association (ARRA) to educate the practitioners on Full Depth Reclamation (FDR). Just-in-time training using the TC3 modules did not result in effective training. See Table 3.

Cape sealing: All three states use this treatment, with one state using this preservation treatment for almost 50% of its preservation work. All three states allow the final surface course to be HMA, while two states allow either a micro surfacing or an HMA as the final surface. One state's cape seals sometimes consist of a double application chip seal, followed by an HMA surface. It was noted by agency representatives that cape seals are outperforming chip seals and thin overlays. It is unclear why and there is no support data available. See Table 4.

Cold in-place recycling (CIR): Only one state regularly uses this treatment. The process begins by milling a depth of 4 to 5 in. and mixing, spreading, and rolling the material. The final step is covering the CIR with 2 in. of HMA. All the CIR sections have higher deflections than the non-CIR, indicating more flexible conditions. The contractors own the reclaimed asphalt pavement (RAP). Thickness checks are conducted between the cold in-place milling operation and the paver. Routine sampling is performed using the AASHTO T2 sampling method. A maximum of 20% RAP can be used in the HMA overlay. See Table 5.

Table 4. Cape sealing

State	Design method	Material type		Construction procedures						
		Aggregate type	Binder type	Chip seal top size	Chip spread rate	Chip binder rate	Surface type	Delay between layers	Marking problems	Rumble strip issues
Kentucky	NA	NA	NA	NA	NA	NA	Micro surfacing or Hot Mix AC	NA	NA	NA
Tennessee	NA	Yes	Emulsified asphalt (CRS-2P, CQS-1HP)	7, 78, 8, or 89	17–30 lb/yd²	0.17–0.45 gal/yd²	HMA	Varies. No standard.	NA	NA
West Virginia	No spec for chip seal, just combination of specs	NA	NA	NA	NA	NA	Micro surfacing or Hot Mix AC	NA	NA	NA

Table 5. Cold in-place recycling

State	CIR type		Construction procedures								
	Foamed asphalt	Emulsion	Plant type		Final surface	Cement admixture	Moisture testing	Cure period before overlay	Traffic restrictions	Minimum thickness	Minimum existing AC remaining
			Central	Roadway							
Kentucky	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tennessee	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
West Virginia	Could be used, technically	Yes	No (otherwise it is not in-place)	Yes	Required, but thickness not defined. Is typically 1.5 or 2 in.	Required (can also use hydrated lime)	Required to be <3% moisture prior to overlay	Minimum 3 days	Fog seal required prior to opening to traffic	3–6 in., but typically 4 or 5 in.	Not discussed in spec, but would prefer 3–4 in.

Table 6. Scrub sealing

State	Material type			Construction procedures					
	Emulsion spec	Aggregate type	Binder type	Crack seal in advance	Blow out cracks before	Binder rate	Fog seal	Commercial broom	Contract work
Kentucky	NA	NA	NA	NA	NA	NA	NA	NA	NA
Tennessee	Polymer-modified asphalt	8 or 89	Rejuvenating emulsion	No	NA	0.25–0.35 gal/yd²	NA	Power broom	NA
West Virginia	Spec references AASHTO M 316	9.5 mm NMAS	Polymer modified	No	Surface required to be swept but not blown out	0.3–0.5 gal/yd² starting point	Required	Broom is required	Yes

Table 7. 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
Kentucky	Yes	NA	NA	No	Yes	No	Fall	Yes	No	NA	NA
Tennessee	ASTM 6690 Type 2	NA	NA	No	Yes	No	NA	NA	NA	NA	NA
West Virginia	ASTM 6690 Type 2	No	NA	No	Not specifically air blowing but specifies that cracks shall be cleaned	No	Based on manufacturer's recommendation	3 in. standard	No	No	Maintenance or contract

Scrub sealing: Two of the three states do not use this preservation treatment. The state that uses this treatment requires the removal of thermoplastic striping in advance of scrub seal placement because of the belief that the scrub seal will not stick and eventually water will get underneath, causing the scrub seal to scab off. This state uses a skid steer with mill attachment to remove the striping and pays for it as a separate bid item. A tack coat is placed prior to scrub seal application. See Table 6.

Crack sealing: All three states use this treatment—two with contractor forces and one mostly with maintenance personnel. Treatment consists of air blowing the cracks (no routing) and then placing sealant. Timing of sealant application prior to future overlays was noted as very important. One state cracks seals in the fall and allows overlays the following spring. Another state prefers to wait three years before allowing overlays. Overband sealant configuration was considered an issue for overlay placement in one state and not the others. Experience has indicated that overband sealant can cause construction issues with HMA overlay placement. Two states pay for sealant by the pound and one by the linear foot. See Table 7.

Rejuvenators: This treatment is not regularly used in any of the states. One state has placed test sections, and one state only uses the treatment for a 2 ft strip over longitudinal joints. The third state does not use it. See Table 8.

Concrete Pavement Preservation

Full-depth repair: Two of the three states have little use for this treatment since less than 2% of the system is concrete, with one state only using concrete on ramps. The state that uses this treatment contracts out most of the work. This state has switched from 6 ft panel sizes to 4 ft panel sizes and has also used precast panels on a demonstration basis. One of the states not using this treatment indicated difficulties getting bidders on concrete repair projects, even after changing the letting dates and bundling projects. See Table 9.

Partial-depth repair: All three states use this technology on a limited basis. All three use milling equipment for removal. It is more common to outsource this activity. Elastomeric polymers are allowed for use. See Table 10.

Dowel bar retrofit: Very little current experience with this technology. Not currently used. One state had a bad experience with dowel bar retrofit.

Joint sealing: Two of the three states seal new concrete pavement using hot pour sealants. One state has been a no-seal state for over ten years. Of the two states that use sealant in new construction, only one reseals as a preservation activity. Hot pour has been specified in one state since 2001 because of silicone sealant failures attributed to limestone aggregate. See Table 11.

Table 8. Rejuvenators

State	Rejuvenator type	Traction abrasive used	Application rate	Agency or contractor applied
Kentucky	NA	NA	NA	Test sections
Tennessee	NA	NA	On longitudinal joints only (0.1–0.15 gal/yd^2)	NA
West Virginia	No	No	No	No

Table 9. Full-depth repair

State	Design					Construction practices				
	Minimum panel length	Dowels	Tie bars	JPCP	CRCP	Repair material	In-house repairs	Contract repairs	Opening to traffic	Diamond grind
Kentucky	6 ft	Yes	Yes	Yes	No	NA	No	Yes	Varies	Yes
Tennessee	6 ft	Yes	Yes	Yes	NA	NA	NA	NA	3,000 psi	NA
West Virginia	4 ft	Yes	Yes	Yes	No	Cast-in-place and precast	Yes	Yes	Project specific	When included in contract

Table 10. Partial-depth repair

State	Distress type		Design		Construction practices					
	Materials-related distress	Spall repair	Repair material specs	Coring in advance	Defining patch limits	Use of milling equipment	Repair materials	Bonding agent	Grouting edges	Warranty
Kentucky	Yes	Yes	Yes	No	Yes	NA	Typically polymer modified	NA	NA	No
Tennessee	No	Yes, on low-speed pavements only	NA	NA	Chain drag	Yes	Fast-track concrete when approved by engineer	No	NA	NA
West Virginia	No	Yes	Yes	Typically yes	Yes	Yes	Conventional & proprietary mixes	Yes	Epoxy bonding compound	No

Table 11. Joint sealing

State	Design				Construction practices					
	Hot pour	Silicone	Compression seal	No Seal	Joint width	Flush fill	Recess sealant	Backer rod	Media blast	Opening to traffic
Kentucky	Yes	Allowed but rarely used	No	NA	⅛ in. wider than existing	NA	NA	Yes, when resealing (not specified in PCC spec)	NA	NA
Tennessee	Yes	Yes	NA	NA	¼ in. for new joint seal, ⅜– ½ in. for reseal	NA	NA	When specified	NA	NA
West Virginia	Yes	Yes	No	No seal	⅛ in. ± 1/16 in.	No	⅛–¼ in. recess	Yes, when resealing	Sandblast	Based on sealant manufacturer's recommendation

KEY OBSERVATIONS

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

Preservation Successes

- Use of equipment certification to ensure proper operation and application of materials
- Use of a designated statewide trainer to assist construction personnel at the beginning of projects
- Development of agency/industry alliances to discuss issues and improve practices and specifications
- Bidding alternative treatments against each other to get more competitive pricing
- Bundling preservation projects into regional or statewide contracts to generate better contractor pricing
- Scheduling bid letting to maximize contractor and equipment availability and time for project completion
- Scheduling of preservation activities, such as crack sealing, in advance of other future preservation activities to prevent any performance issues

Preservation Challenges

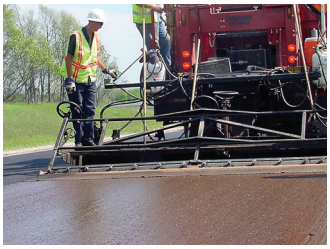
- Loss of experienced inspectors, which affects quality and treatment performance
- Agency training and the changing workforce—people prefer hands-on training with equipment demonstrations
- Lack of projects to bid on, which limits contractors' ability to maintain trained workforce and updated equipment
- Concrete pavement preservation—there is difficulty getting bids on concrete repairs
- Aggregate cleanliness, which is a recurring issue with some treatments

SUMMARY

Seven asphalt and four concrete pavement preservations treatments were discussed in depth (see Figures 1–11). All three states use micro surfacing, cape seals, and crack sealing as predominant asphalt treatments. Predominant concrete treatment is partial-depth repair, but it is used on a limited basis. All agencies are concerned about the lack of experienced inspectors and consistency of contractor work. Sufficient training for the different treatments is a priority for both inspectors and contractors. States agreed that more training could mitigate poor performance. Contractors have ownership of reclaimed asphalt pavement in each state.

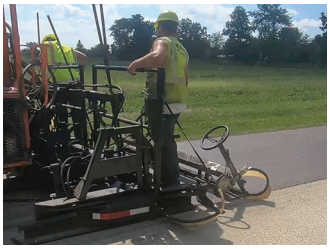
Slurry Pavers, Inc.

Figure 1. Chip sealing



National Center for Pavement Preservation

Figure 2. Micro surfacing



Strawser Construction Inc.

Figure 3. Cape sealing

Pavement Recycling Systems

Figure 4. Cold in-place recycling

Saskatchewan Ministry of Highways and Infrastructure

Figure 5. Scrub sealing

National Center for Pavement Preservation

Figure 6. Crack sealing

Pavetech Incorporated

Figure 7. Rejuvenators

ACPA

Figure 8. Full-depth repair

ACPA

Figure 9. Partial-depth repair

ACPA

Figure 10. Dowel bar retrofit

Dow Corning

Figure 11. Joint sealing

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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:

Kentucky: https://transportation.ky.gov/Construction/Pages/Kentucky-Standard-Specifications.aspx

Tennessee: https://www.tn.gov/tdot/tdot-construction-division/transportation-construction-division-resources/transportation-construction-2015-standard-specifications.html

West Virginia: http://transportation.wv.gov/highways/engineering/Pages/Specifications.aspx

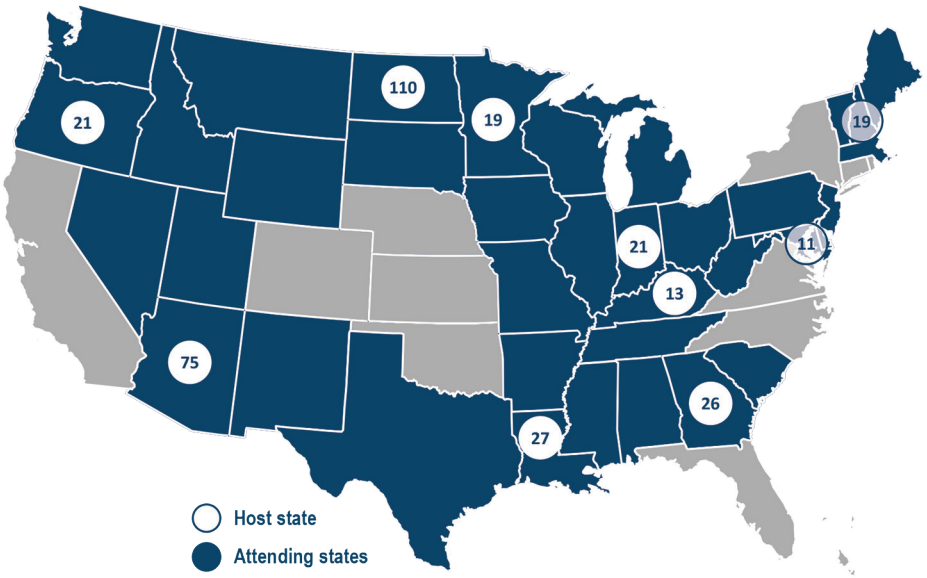
ONLINE RESOURCES

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