Tech Brief

U.S. Department of Transportation
**Federal Highway Administration**

## PAVEMENT PRESERVATION HOW

EDC-4 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 strategies 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 of how to construct pavement preservation treatments with quality materials must be implemented via a technology program aimed at transportation agencies, contractors, consultants, and 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 DOT representatives from Kentucky, two from Tennessee, and two from West Virginia. Mr. Larry Galehouse with the National Center for Pavement Preservation and Mr. Larry Scofield with the International Grooving & Grinding Association and American Concrete Pavement Association acted as facilitators for the day-and-a-half-long meeting. Kentucky was the host state and provided meeting room facilities. Mr. 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 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 strategy, 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 | N/A | 11,000 | NA | CRS-2P | ASTM #9 (⅜ in.) | NA | 16.5–18.5 | 0.28 | 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 (17–45 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 before | Tack before | Sweeping before | 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 strategy. One state bids this strategy 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 a hands-on training with equipment. An example of a 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 strategy, with one state using this preservation strategy 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 strategy. 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 Ext 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 strategy. The state that uses this strategy 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 strategy—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 strategy since less than 2% of the system is concrete, with one state only using concrete on ramps. The state that uses this strategy 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 strategy 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) | 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. Concrete joint sealing and resealing*

| 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 strategies 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

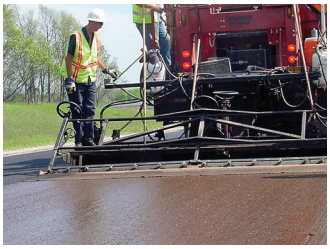
- Loss of experienced inspectors, which affects quality and treatment performance
- Agency training and the changing workforce—people prefer hands-on training with equipment demonstrations
- Lack of projects to bid on, which limits contractors' ability to maintain trained workforce and updated equipment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

## 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.

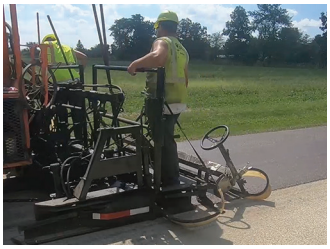
Slurry Pavers, Inc.

*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/.

**KEY WORDS**
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

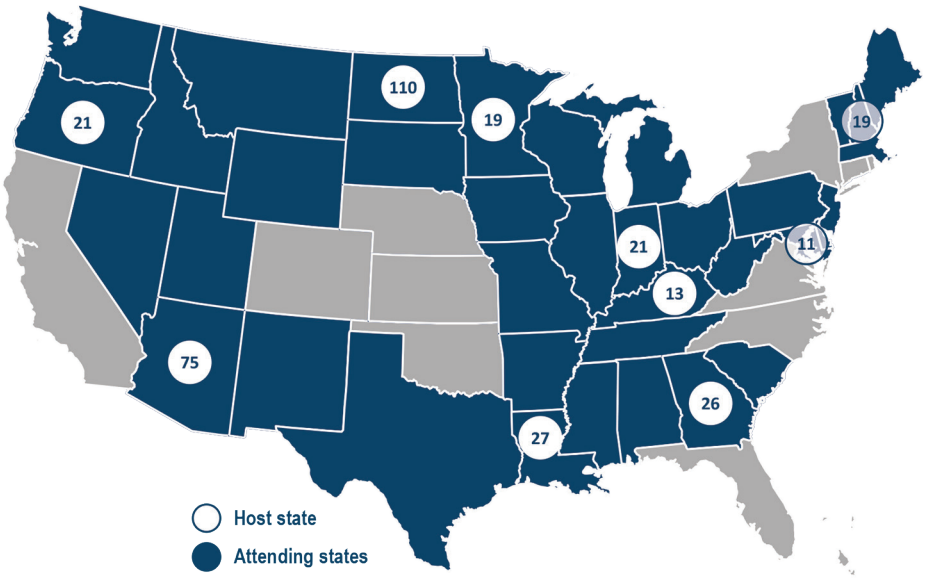
## ONLINE RESOURCES

National Center for Pavement Preservation (www.pavementpreservation.org)

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

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

Pavement Preservation & Recycling Alliance (www.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*