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: OREGON, WASHINGTON, IDAHO, AND NEVADA

EDC-4 PEER-TO-PEER EXCHANGES

INTRODUCTION

On April 30th, 2019, an FHWA-sponsored EDC-4 "How" Pavement Preservation State Peer-to-Peer Exchange was conducted in Portland, Oregon, with 2 FHWA representatives; 13 department of transportation (DOT) representatives from Oregon, 2 from Washington, 1 from Idaho, and 2 from Nevada; and 1 local government representative. 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. Oregon 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 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	Partial-depth repair
Micro surfacing	Full-depth repair
Ultrathin bonded wearing course	Precast slabs
Cape seal	Diamond grinding
Cold in-place recycling (CIR)	—

SUMMARY OF IMPORTANT ISSUES OR SUCCESSES

Asphalt Concrete Pavement Preservation

Chip sealing: All four states successfully place chips seals. Emulsions are principally used for the chip seals, with CRS-2P being the most common. One state has just started using CVRS-2P as a binder, and it is working well. Maximum aggregate size ranges from ½ in. to ⅜ in. Most states fog seal afterwards, and one state uses a choke stone and fog seal. Although all four states use contractors for chip seal construction, two states also use their own maintenance crews.

The largest state program annually places $30 to $40 million of chip seals. That same state has had a plan since 2009 to convert 3,000 miles of hot-mix asphalt (HMA) roadways to chip seals. As a result, the state believes it has saved $120 million already since 2009. One agency uses chip seals to fill ruts up to 2 in. deep to repair studded tire damage.

One state reported that most of the problems it experiences with chip seals involve hot-applied chips seals, while another state has begun to require warranties on chip seals based on Montana's warranty process, where the contractor warrants the chip seal until April of the following year. The impact

of chip seals on rumble strips was discussed as an issue. Chip sealing over rumble strips essentially begins to fill them in, defeating their purpose. It was also noted that if rumble strips are to be installed on a pavement that is to be chip sealed, the rumble strips should be installed first. See Table 2.

Micro surfacing: All four states have used micro surfacing, but two states have discontinued its use, one because of binder setting issues and another because of studded tire damage. A third state is experiencing friction issues soon after placement. The state that uses this treatment the most has not had a failure in five years, and under the state's current specifications the districts are selecting micro surfacing over chip seals.

The biggest issues the states have with micro surfacing seem to be the mix design process and construction quality. Concerns were raised regarding the mix designs and the process by which mix designs are developed. One state believes that its personnel are not properly trained to ensure that calibration and verification are done correctly. The importance of using accredited laboratories and independent third-party verification was discussed. See Table 3.

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
Oregon	See Sections 00710.10 and 00710.11	<5,000	Crushed or uncrushed rock	CRS-2P or HFRS-2P	Nominal ¾ in.	Pre-coat agg. 0.7%–1%	0.004–0.018 yd^3/yd^2	Prime coats: 0.20–0.75 gal/yd^2, fog coats: 0.10–0.15 gal/yd^2	Pneumatic-tire rollers and steel-wheeled rollers	Yes	Yes	NA	Yes
Nevada	See Sections 703 and 705.03.04	NA	See Section 705.03.04	CRS-2P	Type 2: Nominal ¾ in. Type 2C: Nominal ¾ in. Type 3: Nominal ⅜ in.	Disincentive spec	NA	0.1 gal/yd^2 may be required	New surface: 2 pneumatic-tire rollers and 1 steel-wheel roller. Old surface: no less than 3 pneumatic-tire rollers and no steel-wheel rollers.	Yes, power brooms	Yes	Approved methods	Yes
Idaho	See Sections 702.01, 702.03, 702.04, 703.06, and 703.07	NA	See Table 703.06-1 for gradation and Table 703.06-2 for aggregate criteria	CRS-2P	½ in.	205: 0% 403 Class A: 0% 403 Class B: 0% 404 Class A: 0%–2% 404 Class B: 0%–2%	NA	NA	Dump trucks	Yes. Use mechanical rotary type or vacuum broom.	Yes	NA	No
Washington	See 2 tables in Section 5-02.3(3)	<10,000	See Section 9-03.4	CRS-2P	½ or ⅜ in.	0%–1.5%	By engineer. See table in Section 5-02.3(3)	By engineer. See table in Section 5-02.3(3)	Minimum 3 pneumatic-tire rollers	Yes	When specified	NA	Yes

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
Oregon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nevada	See Section 418.02.02	See Section 705.03.06	NA	NA	Hydrated lime (ASTM C1097)	25 lb/yd^2	Yes, 0.75 in. maximum	NA	Yes	Yes, minimum 1,500 yd^2	1–2	Yes
Idaho	Mix design by contractor. See Section 415.03(A).	100% crushed stone. See Sections 703.01 and 703.03.	Polymer-based modifier	NA	Mineral filler: maximum 3% by dry weight of aggregate	NA	No	NA	NA	Yes	NA	Attempted
Washington	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Ultrathin bonded wearing course: All four states have tried this treatment, but spray paver availability is an issue in the region, and as a result, this treatment is not commonly used in any of the states. One state uses an engineered emulsion for the tack and a material transfer device to achieve better control. This state has used the treatment on milled and new asphalt concrete (AC) surfaces. It was noted that cracks reflect through this treatment more quickly than they do with conventional overlays, which are thicker. It was also noted that this treatment is most appropriate for pavements in relatively good condition, and in two of the states the condition of many of the roadways is too poor for this treatment to be used. See Table 4.

Cape sealing: Only one state has used this treatment for highway projects, and in general the experience with cape seals in this region is limited. In the state using this treatment, it is mostly limited to the northern urban areas. The state typically waits seven days after chip placement before placing the micro surfacing. If the chip seal is placed by state maintenance crews, the micro surface may not be placed for up to a year. See Table 5.

Cold in-place recycling (CIR): Although all four states have used this treatment, three of them only have limited experience with it. Historically, one state has used this treatment the most. Most of that state's historical use of CIR was to eliminate thermal cracking, because CIR is very effective at removing thermal cracks if the recycled layer is thick enough. However, because thermal cracking is no longer an issue with the state's pavements, use of the treatment has declined in the state. That state also believes that using an AC overlay as a cap is necessary.

It was discussed that agency specifications should require better control over moisture and binder amounts because contractors typically do their own mix design. Improving the specifications could result in better CIR performance. See Table 6.

Table 4. 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
Oregon	NA	NA	NA	NA	No	NA	1 in. hot mix	NA
Nevada	NA	NA	NA	NA	Limited availability	Eng. emulsion	NA	NA
Idaho	NA	NA	NA	NA	NA	NA	NA	NA
Washington	NA	NA	NA	NA	NA	NA	NA	NA

Table 5. 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
Oregon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nevada	NA	NA	NA	NA	NA	NA	NA	7 days	NA	NA
Idaho	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Washington	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 6. 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							
Oregon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nevada	NA	NA	NA	Yes	NA	No, only quick lime	NA	10 days	NA	NA	3 in. or less
Idaho	NA	Yes	NA	Yes	0.2 ft AC	Use Type II portland cement as specified in 701	Before placing HMA overlay, perform supplemental compaction when the moisture content of the recycled pavement is less than 2%	48 hours	Close road to traffic	0.2 ft	NA
Washington	NA	Yes	NA	Yes	HMA or chip seal	Lime or concrete	<1.5%	3 days minimum depending on moisture content	Pilot car until stable	NA	3 in.

Concrete Pavement Preservation

Partial-depth repair: Only one state uses this treatment to a significant degree. Two states have used it in a very limited capacity, and one state does not use it all. The state that uses it the most contracts out the work and since 2017 has been using polyester and epoxy materials for repairs. The typical repair size in this state is 9 to 12 in. in length and the width of the wheelpath. If the area to be repaired is larger, the state uses full-depth repairs.

One of the two states that occasionally use partial-depth repair constructs only continuously reinforced concrete pavement (CRCP), so usually only spall repairs are needed where the steel is high or to repair deteriorated patch areas. The other state uses Techcrete or Fibercrete for its repair material. That state has recently experienced some failed repairs but is not sure whether the failures are due to the repair material or the substrate. See Table 7.

Full-depth repair: Two of the four states use this repair treatment. The main repair material for one of these states is Rapid Set Concrete Mix, which is placed with mobile mixers. Most of the repairs in this state are done at night. The other state primarily constructs CRCP and has adopted the South Carolina repair method for its CRCP. This repair technique involves simply placing conventional slabs into the existing CRCP with dowels for the transverse joints.

Precast slabs: The four states have only had limited experience with this technology. Three of the four states have had some experience with precast slabs, but two of those three states have only used this treatment on demonstration projects. The third state has used it at several locations, but only for full-depth slab repairs. See Table 8.

Diamond grinding: Two states are the principal users of this treatment, with the major application being to repair damage from studded tires. The treatment has been used for many years in these states, but not primarily for traditional purposes such as smoothness, friction, and noise. One state that does use it for smoothness has also experienced aggregate polishing over time with some aggregates. A 95% coverage rate is often used in that state's specifications. See Table 9.

Table 7. 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
Oregon	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nevada	No	Yes	NA	NA	2 in. back	No	TechCrete and Fibercrete	No	No	No
Idaho	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Washington	No	Yes	Yes	No	3 in. beyond distress	No	Polyester and epoxy	Yes	No	No

Table 8. Precast slabs

State	Design				Use		Construction practices	
	Roman Stone	Illinois Tollway	Fort Miller	Caltrans	Demo project	Routinely use	Bedding type	Panels per shift
Oregon	No	No	Yes	No	Yes	No	Sand bedding	NA
Nevada	No	No	Yes	No	Yes	No	NA	NA
Idaho	NA	NA	NA	NA	NA	NA	NA	NA
Washington	NA	NA	NA	NA	Yes	No	NA	NA

Table 9. Diamond grinding

State	Purpose of grinding				Construction practices			
	Ride quality	Friction	Noise	Buried treasure	Blades per foot	Head width	Smoothness spec	Construction issues
Oregon	Rut removal	No	No	No	NA	NA	ODOT TM 770	NA
Nevada	Yes	No	No	No	52–62	Minimum 3 ft	NA	Polishing issues after construction
Idaho	Rut removal	No	No	No	NA	Minimum 3 ft	NA	Slurry disposal up to contractor
Washington	Rut removal	No	No	No	Groves at 3/32– 5/32 in., no deeper than 1/16 in. Land area at 1/16–1/8 in.	Minimum 4 ft	Yes	Slurry disposal up to contractor

KEY OBSERVATIONS

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

Preservation Successes

- One state reviewed its chip seal performance for a period of about 10 years and found that the treatment's success rate was higher for chip seals constructed by in-house crews than by contractors. The study also indicated that the chip seals that failed were placed late in the season.
- If rumble strips are to be installed on a chip seal project, they should be milled in before the chip seal is placed.
- One state DOT has coordinated chip seal summits since 2006 that include suppliers, contractors, and DOT personnel. The attendees discuss what works and what does not. These summits have been very beneficial.
- The South Carolina full-depth repair method for CRCP has worked very well.
- Better CIR performance can be achieved if agency specifications require better control over moisture and binder amounts.

Preservation Challenges

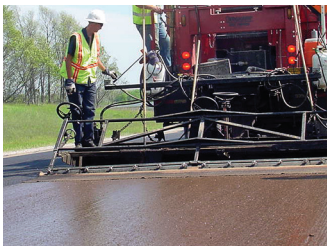
- The desire to achieve optimal mix designs and good construction processes seemed to limit the use of micro surfacing as a treatment in the region.
- Some state budgets limit the tools in the preservation toolbox simply because of the cost of some treatments.
- Inspector training was recognized as an issue in the present and one that would extend into the future.
- For some states, the condition of some roadways has deteriorated to the point that many preservation treatments are no longer an option.

SUMMARY

Five asphalt and four concrete pavement preservation treatments were discussed in depth (see Figures 1–9). Chip sealing is by far the most commonly used treatment in this region. Although many of the treatments discussed have been or are being used by the states, most are not used extensively for one reason or another, whether because of previous performance, cost, existing roadway conditions, or other reasons.

Slurry Pavers, Inc.

Figure 1. Chip sealing

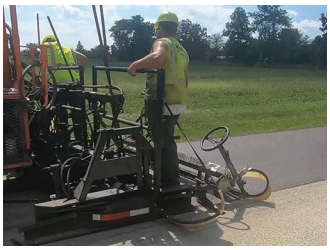


National Center for Pavement Preservation

Figure 2. Micro surfacing

All States Materials Group

Figure 3. Ultrathin bonded wearing course



Strawser Construction Inc.

Figure 4. Cape sealing

Pavement Recycling Systems

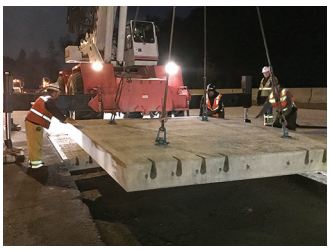
Figure 5. Cold in-place recycling

ACPA

Figure 6. Partial-depth repair

ACPA

Figure 7. Full-depth repair



Shiraz Tayabji

Figure 8. Precast slabs

International Grooving and Grinding Association

Figure 9. Diamond grinding

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JUNE 2020
FHWA-HIF-20-015

This tech brief was developed under Federal Highway Administration (FHWA) contract DTFH61-13-D-00009.

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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:

Oregon: https://www.oregon.gov/ODOT/Business/Documents/2018_STANDARD_SPECIFICATIONS.pdf

Washington: https://www.wsdot.wa.gov/Publications/Manuals/M41-10.htm

Idaho: https://apps.itd.idaho.gov/Apps/manuals/SpecBook/SpecBook18.pdf

Nevada: https://www.nevadadot.com/home/showdocument?id=6916

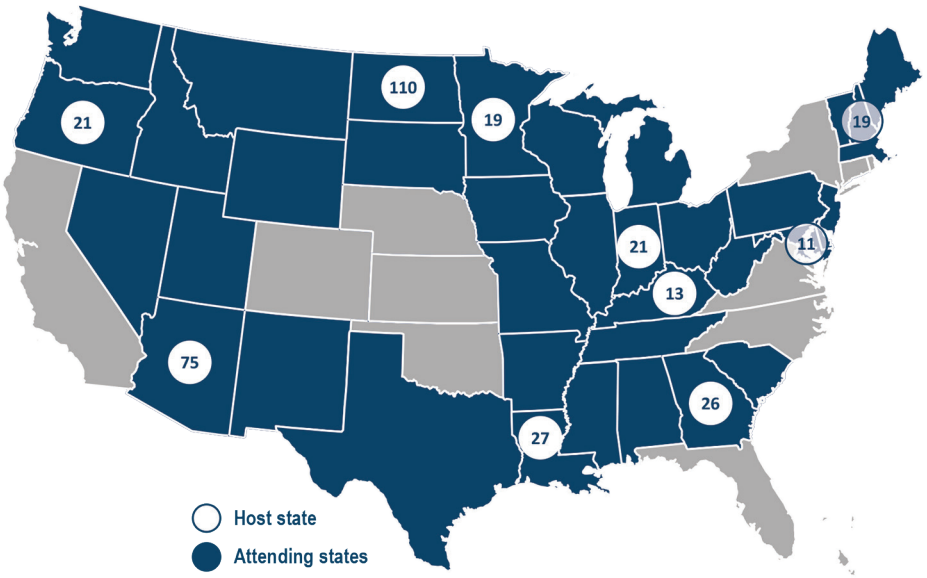
ONLINE RESOURCES

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