VTRC Virginia Transportation Research Council

Cold Central Plant Recycling

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Outline

- Introduction to pavement recycling
  - Benefits and equipment
- Pavement design
  - Empirical and M-E
- VDOT case studies
- Specification resources
- Summary

Pavement Recycling Processes

- Full-depth reclamation (FDR)
  - Pavement foundation
  - Mixed in the road
- Cold in-place recycling (CIR)
  - Upper portions of the asphalt layers
  - Mixed in the road
- *Cold central plant recycling (CCPR)*
  - Similar to CIR but at a mobile plant
  - Can be placed in multiple layers

Why We Should Recycle Pavements

- Time savings
  - Tx DOT
- Cost savings (up to 50%)
  - FHWA, Tx DOT, SC DOT, VDOT
- Environmental benefits (up to 40%)
  - FHWA
- Ability to better address causes of deterioration rather than symptoms

CCPR

- Product is similar to CIR*, process is a little different
  - *Mechanical properties as measured during NCHRP 9-51
- Both combine RAP (up to about 96%), foamed asphalt or emulsified asphalt (3-4%), and cement (sometimes, 1%)
  - No heating other than asphalt binder when foamed
  - May add screenings or other aggregates if gradation needs help

Pavement Design

Most states use either AASHTO '93 and/or Pavement ME

- AASHTO '93
  - Limited because it doesn't consider mechanical properties
  - Layer coefficients range from 0.2 to 0.4
- Pavement ME
  - Existing distress prediction equations (transfer functions) may not be representative

CCPR

- RAP
  - CIR = processed in the road
  - CCPR = hauled from project (to treat foundation) and then back or sourced from existing stockpiles
- Foamed vs emulsified asphalt
  - Both used successfully!
  - Foam introduces a little less water (0.5 to 1%)
  - Mix design requirements and cost

VDOT Case Studies

- Where do we use pavement recycling?
  - Interstates to subdivisions
- CCPR
  - Used as a substitute for asphalt base mixture
  - Benefits to use on top of FDR
- I-81, NCAT, I-64

CCPR

Treatment depths
- Achievable density is the determining factor
- 3-5 inches, up to 6 (per lift)

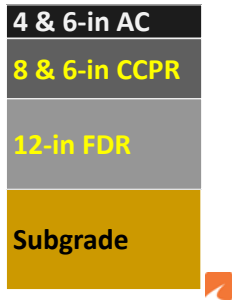
I-81 (2011)

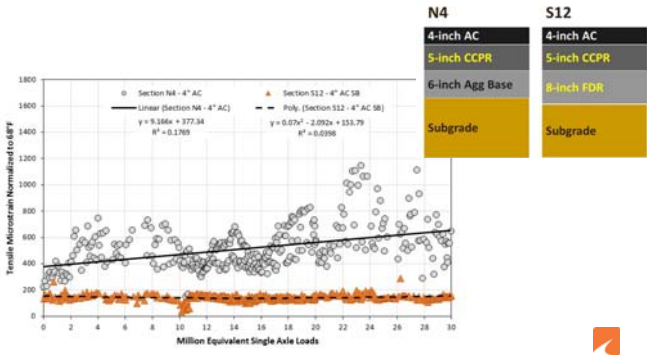
- South of Staunton, VA
- SB direction
- 3.7 miles
- FDR + CCPR right lane
- 29,000 AADT
- 29% trucks

I-81 Performance – Right Lane

- Sept 2024 (13+ years)
  - IRI = 45 inches per mile
  - Rut depth = < 0.1 inches
- Current traffic (Nov 2024)
  - 35.4 million ESALs

Typical layer coefficients:
AC = 0.44, CCPR/CIR = 0.35, FDR = 0.25



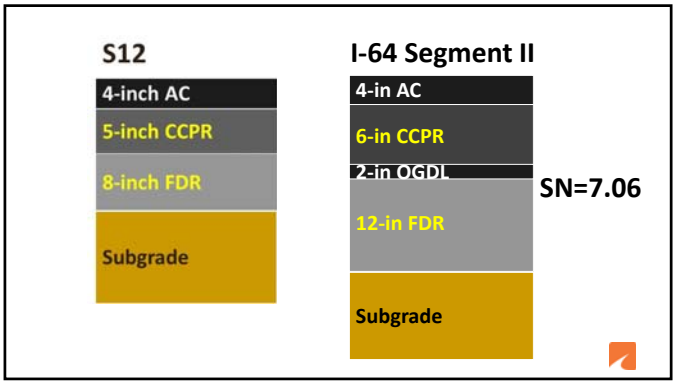


VDOT Sponsored Sections at NCAT

Section	Years	ESALs, millions
New N4	2024-current	<1.5
New S12	2022-current	8ish

VDOT Sponsored Sections at NCAT

Section	Years	ESALs, millions
N3	2012-2018	20
N4	2012-2024	40
S12	2012-2021	30



Recycled Structures

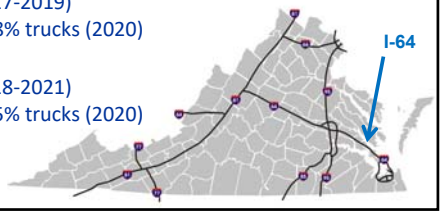
- Recycled content
  - Layer 1 = 12.5% RAP
  - Layer 2 = 30% RAP
  - Layer 3 = 97% RAP
  - Layer 4 = 96% existing material
- Entire cross section
  - 76% recycled

I-64 Construction Sequence

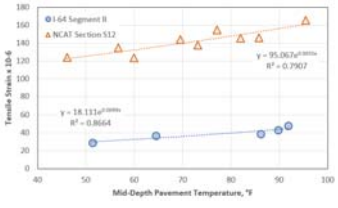
- Add new future left lane and left shoulder
  - Imported FDR
  - CCPR from existing RAP stockpiles
  - New SMA surface
- Shift traffic and reconstruct existing travel lanes and right shoulder
  - FDR of existing foundation
  - CCPR from existing RAP stockpiles
  - New SMA surface

I-64 Reconstruction and Widening

- East and westbound lanes
- Segment 2
  - 7.08 miles (2017-2019)
  - 36,000 AADT, 8% trucks (2020)
- Segment 3
  - 8.32 miles (2018-2021)
  - 37,000 AADT, 5% trucks (2020)



Case Study Benefits



- I-81
  - Showed potential for high traffic application
- NCAT
  - Perpetual-like performance using recycled materials
- I-64
  - recycled more than 500,000 tons of material, >$15 million cost savings

Specifications

- NCHRP 14-43
  - Construction Guide Specs for CIR and CCPR
  - Mix design
    - see AASHTO M 352, R 117, MP 38, PP 94
- Wirtgen Cold Recycling Manual; ARRA Basic Asphalt Recycling Manual (BARM)

Takeaways

CCPR - a proven method for pavement rehabilitation

- Time, cost, and environmental savings
- Applicable to all traffic levels
- Many great examples of specs available nationally from which to borrow

VTRC Virginia Transportation Research Council

We bring innovation to transportation.

Thank you!

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