Virginia DOT's Pavement Recycling Efforts

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Outline

- The past
- The present
- The future

Definitions

- In-place recycling versus in-plant recycling
- Processes
  - Full-depth reclamation (FDR)
  - Cold in-place recycling (CIR)
  - Cold central-plant recycling (CCPR)

Full-Depth Reclamation

- Creates a stabilized base course
  - 4 to 12 inches

Cold In-Place Recycling

- Within the asphalt layers
  - 2 to 5 inches

Cold Central-Plant Recycling

- Similar to CIR
  - Access to deeper layers
  - Stockpiles of existing RAP
The Past: I-81

- Objective
  - Repair a rapidly deteriorating roadway
  - 2-3 year service-life for overlays
- It became…
  - a pavement recycling research study

I-81 Design & Construction

- 30 year design
  - AADT = 23,000 with 28% trucks
  - 102 million ESALs
  - 7.86-8.02 required SN
- Construction
  - 8 months
  - Innovative traffic management
  - $10 million

I-81 Process

- Right lane
  1) Mill 10 inches
  2) FDR 12 inches
  3) 8 & 6 inch CCPR
  4) 4 & 6 inch asphalt overlay
- Left lane
  1) Mill 2 inches
  2) CIR 5 inches
  3) 4 inch asphalt overlay

I-81 Performance Summary

- Summer 2015
  - 4 years ~ 7 million ESALs (right lane)
  - Average rut depth = 0.1 inches
  - Average IRI = 53 / 44 (left / right)
- 3-year performance report selected as AASHTO High Value Research project
  - One of 16 across the country

Present: NCAT In-Place Recycling

N3 N4 S12

NCAT Recycled Sections

<table>
<thead>
<tr>
<th>N3</th>
<th>N4</th>
<th>S12</th>
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<tbody>
<tr>
<td>6-in AC</td>
<td>4-in AC</td>
<td>4-in AC</td>
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<tr>
<td>5-in CCPR</td>
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<td>5-in CCPR</td>
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<tr>
<td>6-in Agg</td>
<td>6-in Agg</td>
<td>8-in FDR</td>
</tr>
<tr>
<td>Subgrade</td>
<td>Subgrade</td>
<td>Subgrade</td>
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</tbody>
</table>
Strain Data

- Strain Data vs. mid-depth pavement temperature, °F

**S12 Recycled Content**

- **S12**
  - 4-inch AC
  - 5-inch CCPR
  - 8-inch FDR
  - Subgrade

- 17 inches manipulated
  - Layer 1 = 12.5% recycled
  - Layer 2 = 30% recycled
  - Layer 3 = 100% recycled
  - Layer 4 = 100% recycled
- Entire cross section
  - 81% recycled
- Perpetual?

**Present: NCHRP 9-51**

- Material Properties for CIR and FDR for Pavement Design
- Partners
  - University of Maryland
  - VTRC
  - Wirtgen
  - Colas Solutions

**NCHRP 9-51**

- 24 projects were cored
- 12-24 months after construction

**Dynamic Modulus Master Curves**

- CCPR
- CIR
- FDR

- Higher temperature
- Lower temperature
Dynamic Modulus Master Curves

- Emulsified Asphalt
- Foamed Asphalt

Higher temperature
Lower temperature

Dynamic Modulus Master Curves

- No Chemical Additive
- Lime
- Cement

Higher temperature
Lower temperature

Repeated-Load Permanent Deformation

- Base Mix
- FDR
- CIR
- CCPR

Future: Using Existing RAP

4.7+ million tons statewide

Using Virginia’s Existing RAP

- With CCPR, we could pave a 12-foot wide lane at 6 inches thick for about 2,100 miles

I-64 Lane Widening

- Add 2 lanes to inside and reconstruct existing 2 lanes
  - Design build, 7.08 miles (segment II)
  - Both directions
  - Project award January 2016
- Using recycling techniques
  - RAP use could exceed 250,000 tons
  - Cost savings could exceed $11 million
I-64 Sequence

- Add 2 lanes to inside
  - 12 foot travel lane and shoulder
    - FDR imported RAP for foundation
    - CCPR imported RAP for base layer
- Move traffic to new lanes
  - Reconstruct existing 2 JRC lanes
    - FDR existing foundation
    - CCPR imported RAP for base layer
- Construct 12 foot right shoulder

VDOT APT Program

<table>
<thead>
<tr>
<th>Lane 6</th>
<th>Lane 5</th>
<th>Lane 4</th>
<th>Lane 3</th>
<th>Lane 2</th>
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<tr>
<td>8” JCP</td>
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<td>6” 21B</td>
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<tr>
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<td>5” CCPR</td>
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Using What We’ve Learned

- Revised VDOT recycling guidelines
  - Layer coefficient
    - CCPR/CIR raised to 0.35 and FDR to 0.25
  - High volume roadways
    - Including interstate projects
- Future work
  - Influence of gradation changes and virgin aggregate / RAP combinations
  - Use of rejuvenators
  - Thinner overlays

Summary

- Recycling can be used successfully on high volume roadways
- Recycling is a way to include RAP as a structural component of a pavement
  - i.e., not a fill material
- We should be including recycling as an option for any new road construction as well as maintenance

Thank you!
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