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INNOVATION & RESEARCH

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Pavement Recycling in Virginia

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Pavement Recycling

- **Recycles existing pavement materials by:**
  - **Pulverizing**
  - **Adding stabilizing agent**
    - Portland cement, foamed asphalt, asphalt emulsion, fly ash, lime, etc.
  - **Repaving (usually as a base course)**
- **An alternative to traditional rehabilitation practices**
  - **Overlay**
  - **Mill and overlay**

Pavement Recycling Processes

1) Full-depth reclamation (FDR)

- **Remixes and stabilizes the bound layers plus a portion of the unbound materials**
  - Typically up to 12 inches

2a) Cold in-place recycling (CIR)

- **Remixes, stabilizes, and repaves a portion of the existing bound layers at ambient temperatures**
  - Typically 3 to 8 inches

Pavement Recycling Processes

2b) Cold central-plant recycling (CCPR)

- Similar to CIR but milled material is processed in a mobile plant (at ambient temperatures) before repaving

3) Hot in-place recycling (HIR)

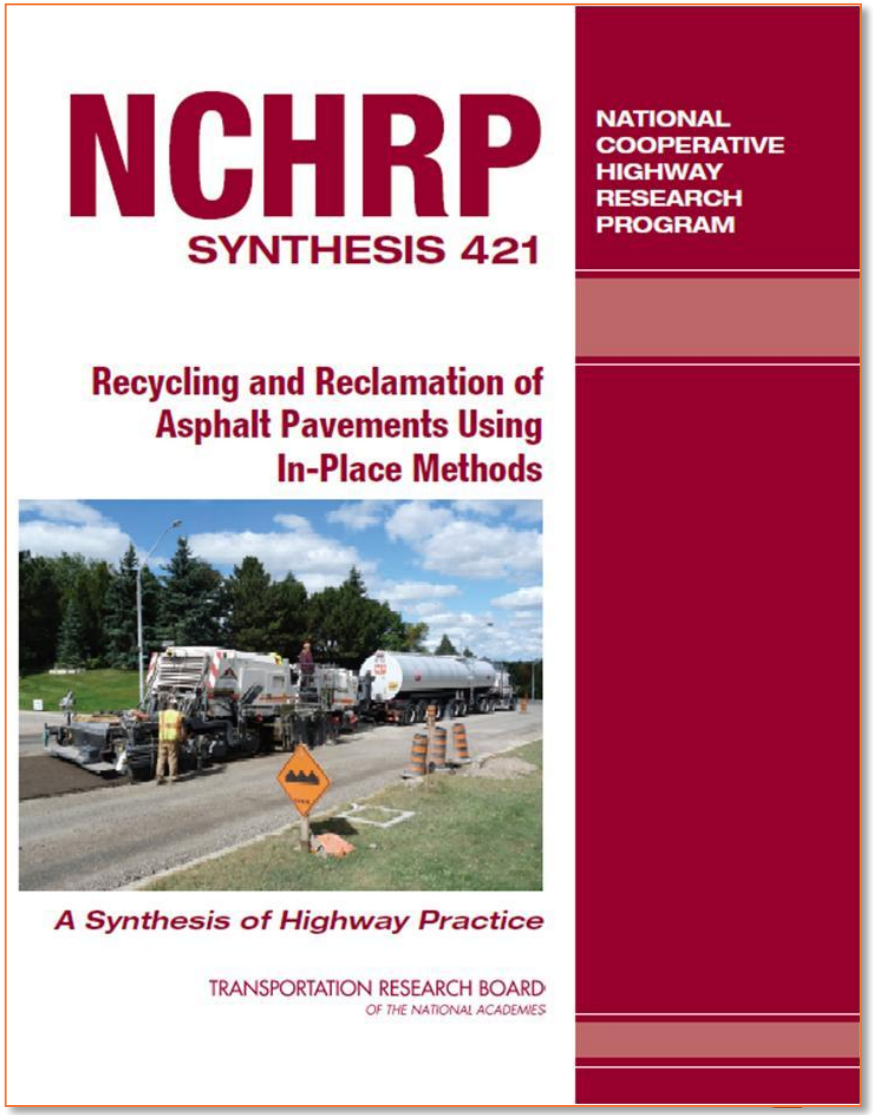
- Upper 1 to 2 inches are heated, scarified, stabilized and repaved

Why VDOT Wants to Recycle

- **Construction**
  - **Fix deterioration causes rather than symptoms**
- **Economic**
  - **Nevada DOT saved $600 million over 20 years using CIR and FDR**
  - **Other studies show 30-50 percent cost savings**
- **Environment**
  - **MTO (Ontario) estimated CIR process emits 50 percent less greenhouse gases**

National Experiences

- 45 agencies responded to questionnaire on usage
  - 75 percent reported some recycling activities
  - 60 percent had more than 10 years experience
  - 13 percent recycled more than 100 lane-miles annually



National Experiences

- **Benefits**
  - Saves new materials
  - Shortens lane closure times
  - Reduces fuel consumption
  - Reduces emissions
  - Cost benefits
- **Barriers**
  - Lack of standardized mix design procedures
  - Limited experience
  - Unsuccessful experiences
  - Lack of specifications
  - Lack of standardized project selection criteria
  - Lack of engineering design

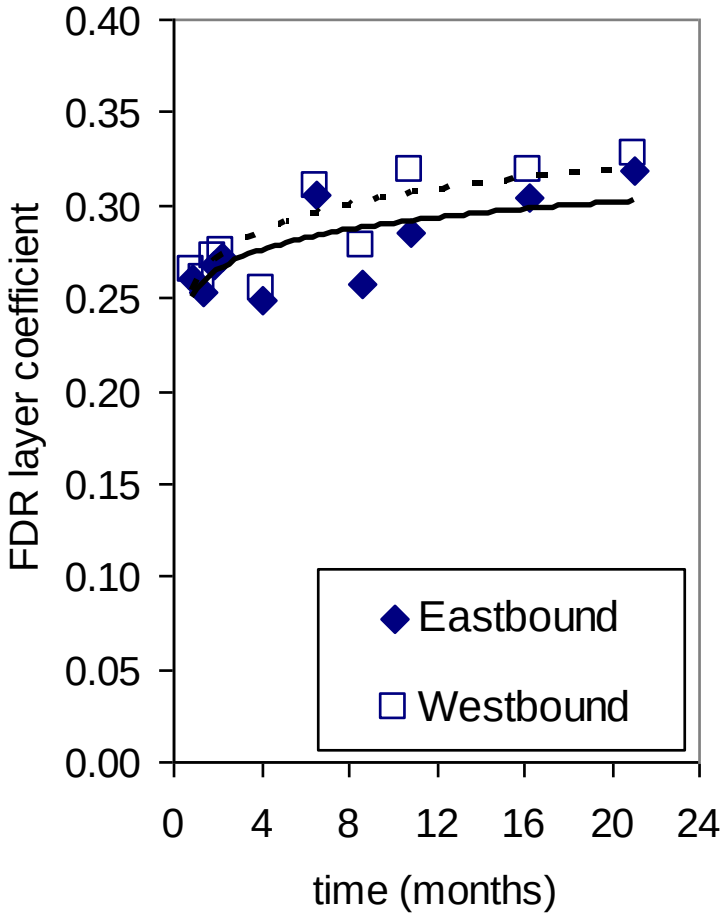
Recent VDOT Experiences

- **FDR**
  - **5 projects, 2008–2011**
  - **Total: 19 lane-miles**
- **CIR**
  - **2 projects in 2011, total 8.4 lane-miles**
  - **1 project in 2012, U.S. 17, Isle of Wight County**
    - 19.5 lane-miles
- **FDR + CIR + CCPR**
  - **I-81, Augusta County**
  - **7.2 lane-miles**

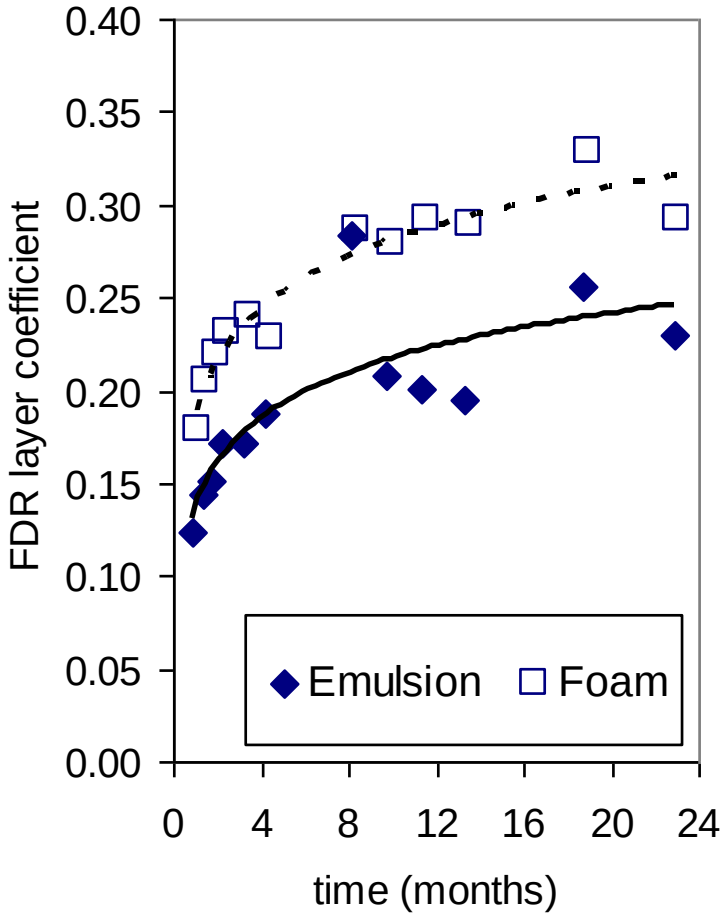
VDOT FDR Projects (2008)

- SR 6 (Goochland), SR 13 (Powhatan)
  - 8-inch FDR using cement
  - Approximately 7 lane-miles each
- SR 40 (Franklin)
  - 8-inch FDR using foamed asphalt and asphalt emulsion
  - Approximately 2 lane-miles
- Research
  - Lab properties, FWD testing over 2 years

Structural Testing with FWD



Cement



Asphalt emulsion and foamed asphalt

VDOT CIR Projects (2011)

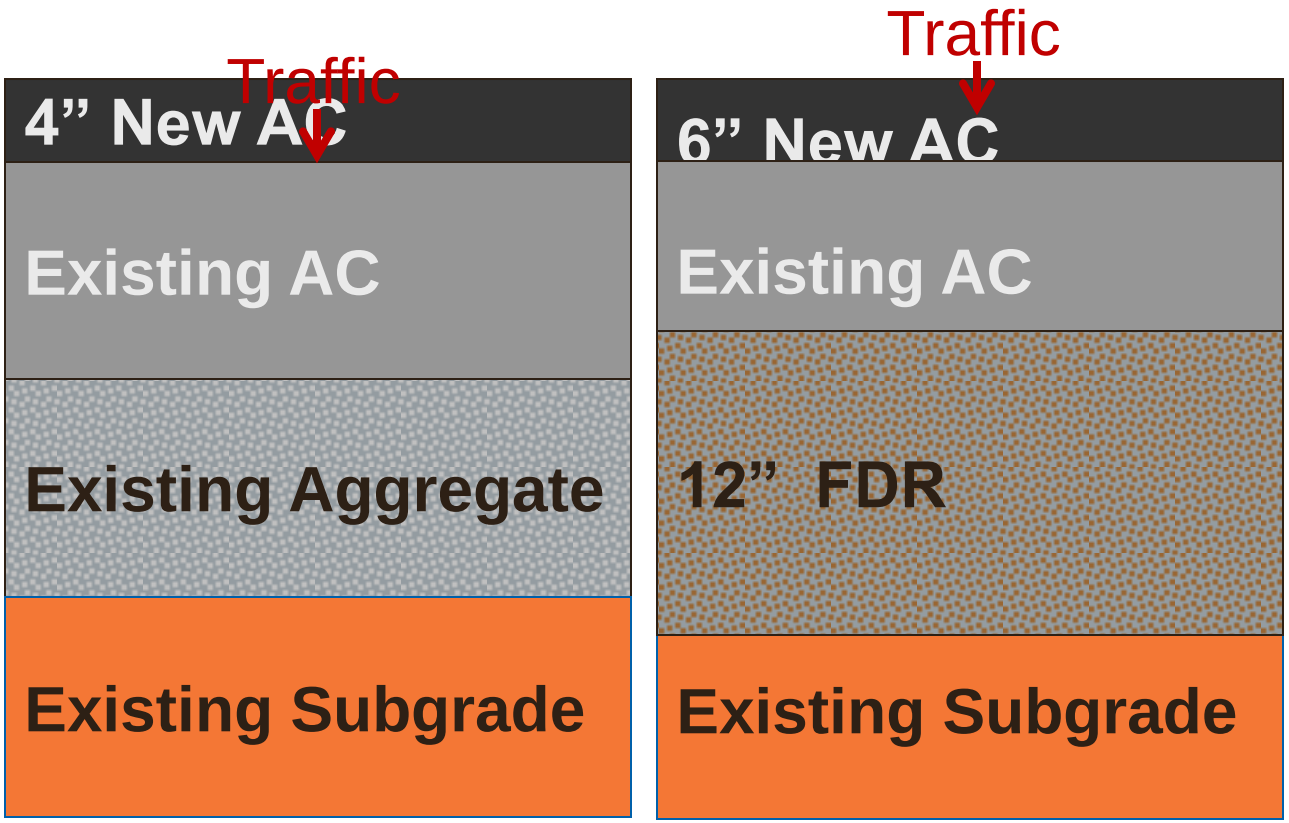
- U.S. 60 and SR 35
  - Approximately 4 lane-miles each
- CIR depth, 3-5 inches
- Asphalt emulsion as stabilizing agent
- 3.5- to 4-inch asphalt overlay
- 3-6 days to complete CIR work

I-81 Pavement Recycling Project

- Southbound lanes, 7.2 lane-miles
- AADT = 21,000 (28 percent trucks)
- Right lane
  - 4 closure periods, 17 days
  - FDR, CCPR and 6-inch AC
  - FDR = calcement (cement + lime-kiln dust)
  - CCPR = foamed asphalt + cement
- Left lane
  - 1 closure, 3 days
  - 5-inch CIR and 4-inch AC

Interstate 81

Original structure = 12 inches AC over
10-12 inches aggregate base



I-81


10 inches


6” New AC
6” CCPR
12” FDR
Existing Subgrade


6” New AC
6” CCPR
12” FDR
Existing Subgrade


6” New AC
6” CCPR
12” FDR
Existing Subgrade


6” New AC
6” CCPR
12” FDR
Existing Subgrade


4” New AC
5” CIR
Existing AC
Existing Aggregate
Existing Subgrade


4” New AC
5” CIR
Existing AC
Existing Aggregate
Existing Subgrade
20 to 30 ft per minute

I-81 Manual Rut Testing, Right Lane

- **After 12 weeks**
  - **Average rut depth less than 0.15 inches**
  - **No statistical difference with respect to time**
  - **Estimated 350,000+ truck passes**

- **Original design vs. modified design**
  - **2-inch AC over 8-inch CCPR**
  - **4-inch AC over 6-inch CCPR**
  - **Statistical difference between sections**
    - 0.06 inches vs. 0.13 inches

I-81 Traffic-Speed Ride & Rut Testing (June 2011)

- **Right lane**
  - **Average IRI = 75**
  - **Average Rut = 0.05 inches (max = 0.19 inches)**
- **Left lane**
  - **Average IRI = 83**
  - **Average Rut = 0.07 inches (max = 0.24 inches)**
- **Will be repeated quarterly through first year**

VCTIR Pavement Recycling Research

- **Laboratory characterization**
  - **Dynamic modulus, flow number, resilient modulus**
  - **Mechanistic inputs for pavement design**

- **Preliminary results (60+ cores)**
  - **Average flow number around 9,000 cycles at 54° C**
    - Rutting susceptibility
    - 10psi confining pressure
  - **Average M_R = 530,000 psi at 20° C**
  - **Average ITS = 74 psi at 25° C**

Pavement Recycling Implementation

- **VDOT districts + VAA + VCTIR**
  - **Specifications**
  - **Standard laboratory specimen preparation methods**
  - **Usage guidelines for pavement designers**

Challenges and Outlook

- **Experience and familiarity**
  - **VDOT/VCTIR relying on experience of others**
    - Is their knowledge “transferable”?
- **How do we move forward?**
  - **Point out potential for cost, time, environmental savings**
  - **Show ability to address causes, not just symptoms**
  - **Research to characterize performance**

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Thank you!

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