U.S. Department of Transportation
Federal Highway Administration

Cold In-Place Recycling Review 2005

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Federal Highway Administration 2005 Cold In-place Recycling State of Practice Review Findings

Purposes of Review:

- Gather “Best Practices” presently being implemented by SHA’s
- Determine barriers and what states did to overcome barriers
- Identify technical advances in equipment, materials, & specifications
- Identify benefits associated with performance/economics

Members of Review Team

Jason Harrington - Pavement Technology

Mike Arasteh - Resource Center – East

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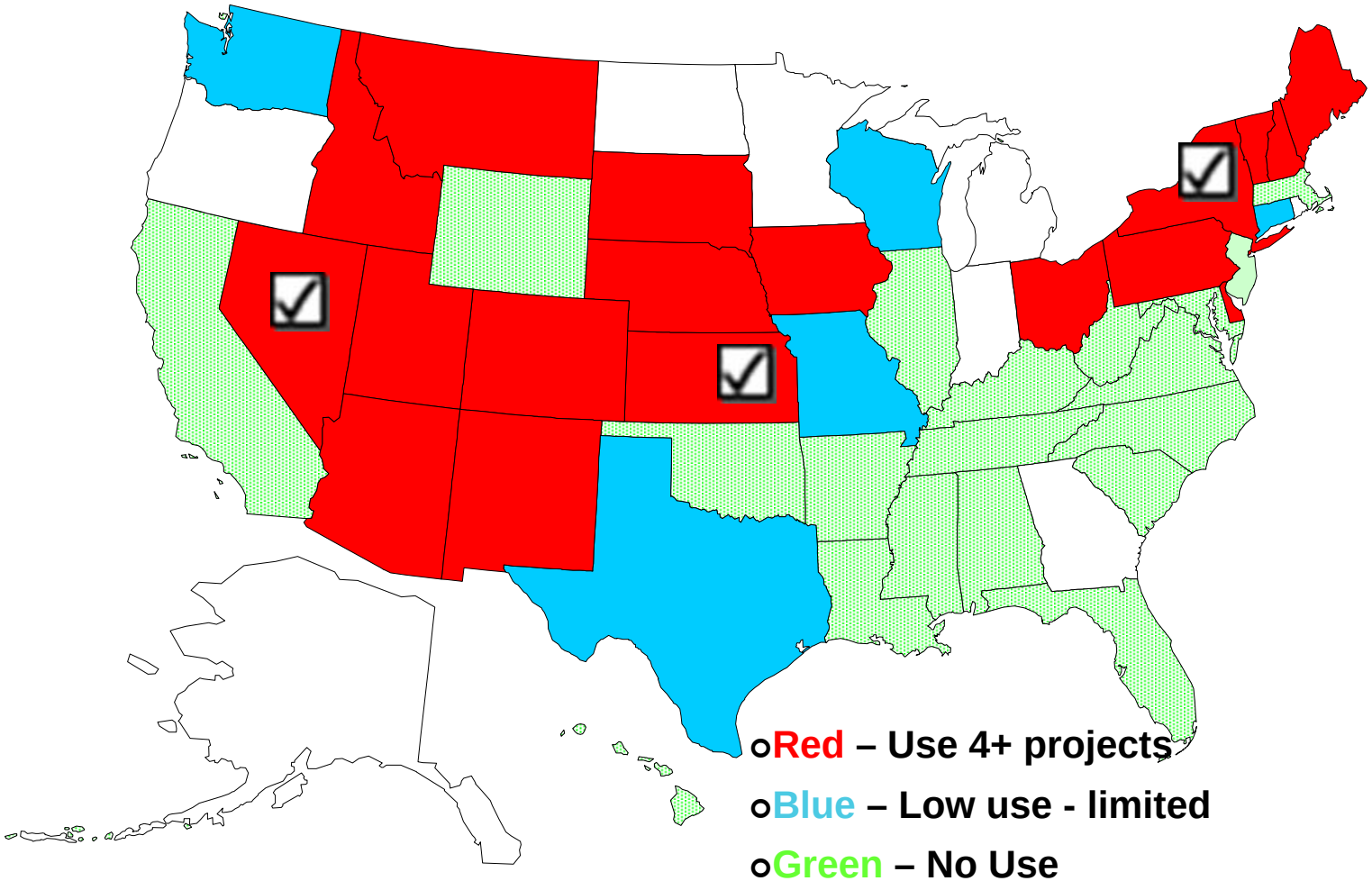
RMRC - Support in $$

Results from questionnaire on CIR

- 41 state DOT ‘s replied to the initial questionnaire
  - 21 states some use CIR on their roads
  - 20 states reported no use of CIR

Findings from Survey



- Red – Use 4+ projects
- Blue – Low use - limited
- Green – No Use
- White – no response

AASHTO SCOM questionnaire

Of the 21 that said yes –

- 9 states use it frequently or starting to increase their CIR projects
  - 6 states (KS, NV, NM, NY,NE, SD) have a well developed program
  - 3 states (IA, MT, and ME) note increasing use
- 4 states have specs but use it on one or fewer projects a year
- 3 use it on only county/local roads
- 6 states really are not using it

State Experience / Anticipated $avings

New York DOT

- Successfully used for 300 projects during the last 15 years.
- Typically average 2 million metric tons per year
- No info on overall savings, but use is economical

Nevada DOT

- Successfully used for 20 years.
- Began w/ 6 projects between ’85 and ’92
- Successfully treated 770 centerline miles (11 %) over the last 9 years
- Permitted savings of $600 million during this period
- Typically realize $40 million annually

State Experience / Anticipated $avings

Kansas DOT

- K-DOT used CIR successfully since 1977(29 years)
  - 1992 to date. Over 6000 lane miles have been cold in-place recycled
- Why?
  - pavement distress to be fixed were early full depth cracking and low subgrade strength. Poor ride from transverse thermal cracking.
  - Quality aggregate availability issues
  - asphalt stripping problems
- Use of CIR in Kansas has improved the pavement smoothness condition significantly to rank them in the top five in the nation for overall ride smoothness.
- CIR is about 45% less cost then a 4” HMA overlay.

Traffic AADT Restrictions for Use

New York DOT

Used on structurally sound roadways having ≤ 8000 AADT & ≤ 10% trucks

And wanting technical info on experiences on higher AADT

Nevada DOT

Used on structurally sound roadways having ≤ 800 AADT

Kansas DOT

K-DOT we don't have that info

Pavement Design Coefficient

New York DOT

- Structural coefficient not used

Kansas DOT

- Structural coefficient value of 0.25-0.28 is assigned to CIR layer.

Nevada DOT

- Structural coefficient used
  - Values of 0.25 to 0.28
  - Back calculated from FWD testing
  - Representative of asphalt treated base
  - Soft subgrade requires subgrade stabilization 8” to 12” using FDR including 2% cement

Design Parameters

New York DOT

Minimum existing thickness

- 4-inches total asphalt
  - 3-inches processed
  - 1-inch remains in-place
- Wearing course cover
  - 1-1/2-inch overlay

Expect 10 –15 year life

CIR withstand traffic for a minimum of seven (7) days before an overlay -a performance-like acceptance mechanism

Nevada DOT

Minimum existing thickness

- 4-inches total asphalt
  - 3-inches processed
  - 1-1/2-inch remains in-place
- Wearing course cover
  - Chip Seal ≤ 300 AADT
  - 2” Structural Overlay ≥ 300 AADT

Expect 15 - 20 year life
w/ lime slurry

Expect 10-15 year life
w/o lime slurry

Design Parameters

Kansas DOT

- CIR 4” of existing Hot Mix Asphalt (HMA) and overlay it with 1½” to 2” of wearing coarse PG 64-28 to PG 76-28 to address the thermal cracking
- 20- 40 core per project, DCP subgrade test of the cores holes, and gives info to SemMaterials they provide the project mix design, construction field adjustments
- For a CIR (4”) using approximately 3% engineered emulsion (PG 58-28), 1.5% Lime.
- Expected to have a service life of 5-10 yrs with little standard maintenance.
- 2% or less moisture content prior to HMA overlay; about 48 hrs.

Performance & Economics

Nevada DOT

CIR 770 centerline miles or 11% of its system since 1997. Typically CIR depth is 7.5cm or 3in

- **CIR can be used without any HMA:**
  - **when 20-year ESAL is 100,000 or less.**
  - **With a strong base, can be placed without HMA overlay for up to 20-year ESAL of 300,000 or less.**
- **Expects a minimum 15 to 20-year life expectancy out of CIR projects**
- **Life expectancy of CIR typically exceeds the life expectancy of the HMA overlay on top of the CIR**

Economics of using CIR

Nevada DOT

The use of CIR & FDR over conventional reconstruction rehabilitation operations has allowed NV DOT to save over $600M while providing long lasting pavements. Subsequently, NVDOT has improved the pavement condition of its system significantly without spending more money.

Kansas DOT

- K-DOT said money has been saved, amount has not be quantified.

Mix Design Criteria

New York DOT

Perform mix design

- Use 6” roadway cores
- Determine
  - % stone added
  - % emulsion content
    - **3% emulsion typical**

Adjustment to emulsion content made in the field

- Payment to 110% bid quantity permitted

Nevada DOT

Mix design typically not performed. In 2005

- Assume 1.5% lime slurry
- Assume 1.5% CMS-2s emulsion
- Adjustment to emulsion content made in the field (1%-1.5%)

Add Stone

NY DOT

End Results

Add Stone on top

CIR Equipment

NV DOT

Lime Slurry

CIR Train

Milling

Milling Teeth

Vibratory Roller

Processed Material

Density Specifications

New York DOT

- Density spec not used
- Completed CIR mat subjected to full traffic for 7 days prior to overlay
- Rutting limited to ≤ ½-inch

KDOT relies on test strips to establish density targets.

Nevada DOT

- Use Density specification
  - Establish optimum relative density from 1000' test strip
  - Require target density of 98% optimum density w/ no test < 95% optimum density
  - Density may be increased 2% to 3% by re-rolling 3 to 15 days later
  - Surface placed after 10 to 45 days cure- full traffic

Ride Specification

New York DOT

- No ride specification
- 2005

Nevada DOT

- Uses ride Specification
  - California profiliograph
  - Roughness limited to 5” per mile when overlay is used for surface
  - Roughness limited to 10” per mile when chip seal is used for surface

KDOT ride specification has resulted in an overall better quality workmanship.

Contractor Influence to Process

New York DOT

CIR specialty contractors

- Require large capitol investment
- Require highly trained specialty work force

Contractors:

- Recognize importance of quality workmanship
- Recognize unacceptable cost of failure

Contractor Influence

Nevada

- Availability of specialty CIR contractors limited factor (2005)
- CIR contractors work multiple states
  - Scheduling conflicts
  - Specialty sub-contractors and general have to coordinate
- Building “boom” in west negatively effects availability of skilled labor force and materials (2005)

Best Practices- Industry Partnerships

New York DOT

- Strong partnership with LADA (Liquid Asphalt Distributor's Association)
  - Industry working with county engineers:
    - 30 year history
  - Industry working with state engineers:
    - 20-year history

Nevada DOT

- Strong partnership with specialty contractors
  - Successfully State history

Kansas DOT

- Partnership between emulsion supplier, CIR construction industry
- Annual meetings to review specifications and prior construction year issues has aided in improvements in the overall program.
- 20+ years of partnership

Best Practices/ Pre-construction Meetings

New York DOT

- Pre-construction meeting 1-week prior to construction
- Pre-pavement meeting first day of construction

Nevada DOT

- Mandatory Annual Lessons Learned meeting
- Mandatory 2-hour workshop prior to construction

KDOT equipment specification to have: gradation screed, belt WIM scale, and secondary crusher to produce in-spec gradation materials and controls for metering of lime and emulsion.

•Pre-construction meetings

Best Practices- Contracting Mechanism

New York DOT

Traditional contracting mechanism cumbersome:

- **Too slow**
- **Makes specialty contractor sub to prime**

Utilize Office of General Services (OGS) contracts

- **Annually develop list of "Approved" contractors**
- **State requests Contractors annually submit line item quotes on materials and/or activities**

"Quick Quote" requested once specific conditions of project are known

- **"Quick Quote" prices can not exceed original quote**

Recycled Materials Resource Center – Another Partner

Center has several research projects reports that are focused on CIR technology.

- Determination of N-design for CIR Mixture Design Using the Super Gyratory Compactor (SGC)
- Laboratory Foamed Asphalt Producing Plant
- Determination of Structural Layer Coefficient for Roadway Recycling Using Foamed Asphalt
- CIR Design Guide for Emulsion using SGC
- www.recycledmaterials.org/

Questions?