Cold In-Place Recycling Review 2005

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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

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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 Savings

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 Savings

• 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 than 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

Expect 10-15 year life

w/ lime slurry

w/o lime slurry
Design Parameters

- 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.
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%)
NV DOT

Lime Slurry

CIR Train

Milling Teeth

Vibratory Roller

Milling

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

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

**Nevada DOT**
- Uses ride Specification
  - California profilograph
  - 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
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?

The End