What’s MnDOT’s Working

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Topics

• When to chip seal
• Fog Seal Research
  – CFS-1h
  – Value of fog sealing
• Dealing with Pavement Markings
• Micro Milling with Chip Seal or Micro Surfacing
• Micro Surfacing Research
• Texas Under Seal
When to Apply Chip Seal

• Built an aging study
  – Because 15 years take 15 years

• 3 inch Mill & Fill 1999
  – PG 58-28 binder
  – Chip seal 1 mile section each year starting in 2000
  – Last sections was chip seal 2004
Aging Study

- Cored in 2011 for Asphalt Institute study
- Wanted to see what effect PM has on aging
- When is best time
## MINNESOTA TH 56 SITE LAYOUT

<table>
<thead>
<tr>
<th>14 TO 15</th>
<th>13 TO 14</th>
<th>12 TO 13</th>
<th>11 TO 12</th>
<th>10 TO 11</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>2001</td>
<td>2002</td>
<td>2003</td>
<td>CONTROL</td>
</tr>
<tr>
<td>1 YEAR</td>
<td>2 YEAR</td>
<td>3 YEAR</td>
<td>4 YEAR</td>
<td>Age when treated</td>
</tr>
</tbody>
</table>

**ORIGNAL CONSTRUCTION- 1999**
TH56 Cores

- Cores
  - Remove chip seal (if any)
  - Cut into two 25-mm layers
  - Test for fracture energy (cracking potential)
  - Recover component asphalt to check aging
Disk-Shaped Compact Tension Test: DC(T)
DC(T) Results: TH-56

Higher fracture energy is better
TH56 Findings

• Sealing improves resistance to aging (cracking)
• Sooner is better when sealing
  – Waiting for 3 or more years to seal after construction produced similar results as unsealed pavement related to DCT
  – Sealing after 1 or 2 years showed improvement in resistance to aging (cracking)
Ride Data

TH 56 IRI Average

- **Control Section Paved 1999**
- **Chip Sealed 2004**

Expon. (Control Section Paved 1999)
Expon. (Chip Sealed 2004)

Crack Repair Done

5 Years

R² = 0.9609
R² = 0.9131
Control Section Never Chip Sealed
Last Section Chip Sealed 2004
Life Extension of Chip Seal Needed to Break Even

- New Construction 2013
- Thin Over Lay no mill Mix $55/T
- Heavy Mill & Over Lay $60/T

Years of life ext need to be cost effective:
- 0.3
- 3.0
- 2.4
Fog Sealing Research
Issues with fog sealing

- Slow curing rate
- High cost of traffic control
- Limited working hours
Developing Faster Setting Emulsion
CFS-1h
What is it

- Same base asphalt as CSS-1h
- Uses Rapid Set emulsifiers
- Designation CFS – 1H
  - Minimum 30% residual asphalt
  - Not diluted in field
  - Pen range 40 to 90 pen
  - Sieve 0.1% max
- Cost similar to diluted CSS-1h
Value of Fog Sealing
Why Fog Sealing Shoulders
(Picture taken in 2009)

Fog Seal applied 2001
Fog Sealing still working after 4 years
Value of Fog Sealing over chip Seal

![Graph showing the value of Fog Sealing over chip Seal with data points and regression lines for MP 88 and MP 89 no fog, with R² values for each line.](image-url)
Pavement Markings
Dealing with in place Pavement Markings

• Trouble with de-bonding of chip seal

• 2 Options
  – Grind off
    • Cost $0.85 to $1.00 linear foot
  – Prime
    • CRS-2p 0.10 to 0.15 gal/y²
    • Cost $0.02 to $0.03 linear foot
Micro Milling with PM Treatments
Micro Milling with Chip Seal or Micro Surfacing

• Why?
  – To improve ride

• What are the performance targets
  – Equal to 1½ inch over lay
  – Quicker than overlay
  – Less costly overlay
    • Chip seal 40% of the cost of 1½ inch over lay
    • Micro Surfacing 60% cost of 1 ½ inch over lay
Micro Milling
Micro Milling with Chip Seal
Results for Chip Seal
Results Micro Surfacing

TH12 District 8
(RP 67.364 - 73.893)

IRI (in/mi)

Before | After Micromill | After Miromill and Microsurface

0 | 80 | 40
Micro Surfacing Research

• Methods to reduce snow plow damage
  – Softer base Asphalt
    • 2013 and 14 allowed PG 58-28 in place of 64-22
    • Required in 2015
    • Designation CQS-1p
    • Will allow PG 49-34 for construction season 2015
      – Two project built successfully so far with PG 49-34
  – Have seen less snow plow damage on pavement markings with softer based asphalt
Micro Surfacing Research

- Allow use of SBS modified asphalt in place of latex modifications
  - Contractor/Supplier choice
- Increase asphalt content micro surfacing
  - Increased from 8% to 10%
  - Increased life
  - Smoother surface
Questions to be answered

• Can a surface treatment such as Micro Surfacing be used to improve ride and hold worn out pavement together for 5+ years?
• Will higher asphalt content Micro Surfacing last longer on high volume roadways?
• Will higher polymer loading and softer binder in Micro Surfacing emulsion reduce reflective cracking?
Before condition Cell 1
Research method

- Cell 1 received the following
  - Tack coat of CSS-1h diluted
    - Application rate 0.10 gallons per square yard
  - Micro Surfacing
    - Granite
    - Gradation used: MnDOT Type II
    - Scratch course: 12lbs./SY
    - Surface course: 15lbs./SY
Research method

- Emulsion used
  - 6% Kraton polymer modified base asphalt
  - instead of 3% post added latex
  - Base PG 49-34 instead of PG 64-22
  - 16% add emulsion instead of 13%
  - 10.25% AC instead of 8.3% AC
Results

Cell 1 Ride Data

- Micro applied

- Driving
- Passing
Cell 1 after Micro Surfacing
Texas Under Seal
Texas Under Seal

- Chip Seal applied before HMA Overlay
  - Milled surface
  - Non milled surface
- ⅜” minus chip
- CRS-2p
- Light on cover aggregate
- Can pave as soon as rolling & sweeping is completed
PM Performance Data

Performance of Texas Under Seal

- Texas
- Control

Control Section Performance
Texas Under Seal

• Why does it perform
  – Acts as stress relief membrane?
  – Super Tack?
    • Have had other tack methods with higher peak strengths
  – Limits water infiltration from base?

• As of end of 2014 construction year 8 projects have been built
Questions?