Fog Sealing more then a shot in the dark

Thomas Wood
Fog Sealing
Topics

- What is a Fog Seal?
  - Chip Seal
  - National Sealer Study
  - Shoulders
  - Recreational Trails
Fog Sealing Chip Seals

- What are the Benefits of Fog Sealing of a chip seal?
  - Construction Issues.
Fog Sealing Chips Seals

MN/DOT started fog sealing chip seals in 1999 to reduce dust from limestone chips. 2001 put requirement to fog seal all chips seals on State projects.
What is a Fog Seal?

- It is a light uniform application of asphalt emulsion.
- Normally CSS-1h or SS-1h
- Cationic or Anionic
- Strongly recommend it be diluted.
  - Lower viscosity
  - Better penetration
- Application rate between .06 to .20 gallon per square yard diluted.
Why Fog Seal Chip Seal?
How does Fog Sealing help limit snowplow damage?

- Increased embedment.
  - Additional residual asphalt.
  - Accelerates curing of pavement because of dark color.

- Combination of binders.
  - Combination of soft elastomeric asphalt underneath and harder asphalt over top.
Other benefits of Fog Sealing
Chip Seals

• Locks down marginally embedded chips.
• Makes pavement marking more visibly.
  – Reduces amount of paint needed.
• Customer perceives surface treatment as a new HMA overlay not a chip seal.
Construction Issues

• No rain forecasted for next 3 hours
• Environmental conditions dictates speed of cure.
• Proper nozzle size for uniform application.
• Properly functioning equipment and qualified operator.
• Overlap the centerline at least 1 foot.
• Light coat of sand in intersections/high volume areas.
What the Traveling Public See!
3 Years after Fog Seal
Spray Applied Polymer Surface Seals Study
Helen & Gayle King
Test Section Locations

  - 3 Surfaces (dense, rubber, chip seal), 18 test sections
- **CA - 78, Salton Sea (2001)**
  - Asphalt rubber surface, 5 sections
- **CA - I-5, Marysville (2002)**
  - Dense-graded surface, 6 sections
  - Site abandoned – problems with field application rates
  - Dense-graded surface, 8 sections
- **MN - County Rte 112, Rochester (2006)**
  - Coarse Superpave surface, 8 sections
  - Sanding study; evaluate early friction
  - New trial with WRI study: Fall '06
  - Newly constructed pavement
Evaluation Approach

- Chemical & rheological testing
- Friction & texture measurement
- Non-destructive testing for assessing when to apply treatments
- Distress evaluation
- Permeability/infiltration testing
The Spray Applied Seal Study

• Lowest cost preventive maintenance treatments
  – Fog seals
  – Rejuvenator seals
• Are they effective?
• Are they safe?
Fog Seals:
Study Objectives

• Evaluate Effectiveness of Fog Seals
  – Sealers
  – Rejuvenators
• Optimize Timing Of Applications
  – Evaluate potential technologies for determining “triggers” or intervention points
• National and Local Technology Transfer
The Project

• Information gathering
• Field projects & testing
  – Evaluate effectiveness of sealers & rejuvenators
  – Optimize timing of applications
• Lessons learned information sharing
  – Workshops, CD,
    www.pavementpreservation.org/fogseals/
1. DOT Survey

- Currently use fog seals
- Have used in the past
- Don’t use
- Didn’t respond
Lessons Learned

MN 251 fog seal after 4 yrs in light rain

Fog seal preventing water intrusion
Why Fog Seal?

- Close or Seal Cracks
- Reduce Shrinkage
- Pitting/Raveling
- Reduce Oxidation
- Decrease Permeability
- Construction Defects
- Reduce Shrinkage
DOT Survey
Surface Types That Are Fog Sealed

- Micro Surfacing
- Slurry Seal
- Chip Seals
- OGFC
- Dense Graded

Bar chart showing the percentage of each surface type affected by fog sealing.
DOT Survey
Are Fog Seals Cost Effective?

- Yes: 20 respondents
- No: 1 respondent
Friction of Newly Treated MN TR 112 With & Without Sand

Sanding increases friction

From Dynamic Friction Tester/ Circular Texture Meter immediately after application and curing. Tested by North Central Superpave Center
Fog Seal Products

• Sealer emulsions
  – SS/CSS; CSS-1hP; Ralumac®
  – RS/CRS; CRS-2Pd, HFE-100S
  – QS/CQS: LD-7®
  – Gilsonite-based: GSB®-Modified

• Rejuvenator emulsions
  – Oils: ETR-1; ARA-1; Reclamite®
  – AC/Oil: Cyclogen®; ERA®
  – PMAC/Oil: Pass QB®
Fog Seal Products

- Products differed greatly
  - Curing time
  - Effect on friction
  - Ability to soften existing binder
  - Tracking
  - Dilution rate
  - Application rates

- Supplier recommendations should be followed

- Product selection should be determined by:
  - Project goal (sealing or rejuvenating)
  - Surface type (dense-graded, open-graded or chip seal)
Fog Seal
Field Test Methods

- Pavement permeability
- Emulsion infiltration
- Surface modulus or “m-value”
- Friction
- Surface texture
Fog Seal
Friction & Texture Testing

• Dynamic Friction Test
ASTM E-1911

Portable, easy-to-use, repeatable
Comparison of Friction Tests - MN251
2006 Trial

DFT/CTM portable, easy-to-use, results correlate with full scale test

IFI as measured by DFT/CTM (ASTM E1911/E2157)–Tested by North Central Superpave Center
Full-Scale Tire Testing (ASTM E274) – Tested by Mn/DOT

Lessons Learned

<table>
<thead>
<tr>
<th>Friction Number</th>
<th>IFI (x 100)</th>
<th>E-274 w Smooth Tire</th>
<th>E-274 w Ribbed Tire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRS-2P(d)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LD-7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pass QB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reclamite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chip Seal/CRS-2Pd</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IFI Tested Same Day, E-274 Several Days Later

$r^2 = 0.9019$ for Smooth Tire
$r^2 = 0.9125$ for Ribbed Tire
Field Observations

• Notes & photos of MN, AZ & CA projects taken in 2005 & 2006
  – Although some 2001 and 2002 seals not clearly visible, effects of treatment were
Summary

- Fog & rejuvenator seals inexpensive & effective pavement preservation techniques
  - Provide lasting protection
- Primary constraint: friction loss
  - Friction returns after time
  - Sanding helps significantly
  - Traffic control essential
- DFT / CTM useful for quick friction testing
- Seals effective over chip seals, OGFC, shoulders
  - Prevent raveling
  - Prolong service life
- Equipment calibration essential for success
- Performance-related specs need to be developed
- Full reports on project at: www.pavementpreservation.org/fogseals/
Study Participants – Acknowledgements

• Federal Highway Administration (FHWA) - Sorenson
• Foundation for Pavement Preservation (FP2) - Eller
• Arizona Department of Transportation (ADOT) - Scofield
• State DOTs: MN, CA, AZ, MI
• GHK, Inc.
Research Participants
Acknowledgements

- Western Research Institute
  - Binder extraction/ chemical & rheological tests
- North Central Superpave Center
  - Friction/permeability
- Mathy Technology & Engineering
  - Dynamic shear rheometer – torsion tests
- University of Minnesota
  - Bending beam rheometry on thin mix
- University of Texas at El Paso
  - PSPA
- Akzo Nobel
  - Emulsion surface tension & particle size tests
Industry Participants
Acknowledgements

- Tricor Refining
  - Reclamite; ERA-1; ERA-25
- Western Emulsions
  - Pass QB
- Blacklidge Emulsions
  - LD-7
- Asphalt Supply
  - GSB-Modified

- Koch Materials
  - CSS-1
- Flint Hills Refining
  - CRS-2Pd
- Paramount Refining
  - CSS-1
The Road Never Traveled!
What new in Fog Sealing?

- Polymer modified asphalt emulsions
  - CRS-2pd
    - Withstand UV aging better than non-modified asphalts
    - Cures faster
    - Less tracking
Why?
How?

• Used Css-1h diluted
  – Seem to disappear within two years

• Now use CRS-2pD
  – Withstands UV aging better than non-modified asphalts
    • Still black after 4+ yrs.
  – Cure faster
  – Less tracking
• Better friction # with CRS-2pd then Css-1hd
  – Mid 30’s verses low 20’s same shot rate.
• Protects rumble strips
• Increase visibility of pavement markings.
• Public likes looks of roadway!
Recreational Trails Why Preventative Maintenance?
New Paving is Very Costly
IRI +2000 inches to mile
Fog Sealing

- **CSS-1h diluted**
  - 0.06 to 0.12 g/s²
  - Perceived as have very short life
- **CRS-2pd**
  - More resistant to UV
  - Quicker curing
  - Less tracking
• Cold Tar sealers
  – Compatibility issues with HMA
  – Environmental issues
    • PAH (Poly-aromatic Hydrocarbon) run off
      – Austin, Texas USGS sponsored study
    – Not compatible with other treatments.
• Proprietary products
  – Can be costly because limited bidding
  – Unknown performance
Questions?
Thank You!