Tack Coat Best Practices

FHWA Cooperative Agreement Subtask
Tack? Who needs Tack?

Or Rollers?
OK – here’s a little tack for you!
OK, OK, we’ll use the distributor
OK, OK, we’ll use the spray bar
You want tack – we’ll give you tack
Tack Coat Best Practices Outline

• Terminology
• Purpose of Tack Coats
• Consequences of Poor Bond
• Relative Cost for Tack Coat
• Tack Coat Difficulties
  • Contractor
  • Agency
• Materials
  • Traditional
  • New Materials
  • Selection
Tack Coat Best Practices Outline

• Handling and Storage of Tack
• Tack Coat Field Operations
  • Manuals of Practice
  • Research / Bond Strength Testing
  • Best Practices
    • Surface Preparation
    • Truck Setup
• Tack Coat Application Calculations
• Spray Pavers
• Review and Summary
  • Common Tack Coat Questions
  • Areas of Known Agreement
Consequences of Poor Bond

- Layer independence
  - Reduced fatigue life
  - Increased rutting
  - Slippage
  - Shoving
- Compaction difficulty
- Typically limited to local areas of high stress
  - Braking areas
  - Curves
Days later!

Courtesy of Road Science
Purpose of Tack Coats

• To promote the bond between old and new pavement layers.
  • To prevent slippage between pavement layers.
  • Vital for structural performance of the pavement.
  • All layers working together.
  • To be applied along all transverse and longitudinal vertical surfaces.
Bonded Demonstration

- Mini Michael Jackson - ~60 lbs
- 11 sheets of plywood:
  - 48” x 8” x 11/32” each
- Measure deflection over 36” span
- Compare effect of full-slip versus fully bonded plywood sheets

Courtesy of Wayne Felix
Bonded Demonstration

2 5/8" Unbonded

1/8" Fully Bonded

21 Fold Difference
Loss of Fatigue Life Examples

• May and King:
  • 10% bond loss = 50% less fatigue life

• Roffe and Chaignon
  • No bond = 60% loss of life

• Brown and Brunton
  • No Bond = 75% loss of life
  • 30% bond loss = 70% loss of life
8 – 10 years (est.) Interstate Pavement
Cores Showing Debonding

Bonding Failures
Debonding at the NCAT Test Track

National Center for Asphalt Technology
at Auburn University
Strain Investigation

Strain Ratio = \( \text{Strain}_{7''} / \text{Strain}_{5''} \)
Common Tack Coat Materials

- Emulsified Asphalt
  - Most common option
  - SS-1, SS-1H
  - CSS-1, CSS-1H
  - RS-1, RS-1H, RS-2
  - CRS-1, CRS-2
  - PMAE

- PG Graded Binders
  - Neat Binders
    - PG 58-28
    - PG 64-22
    - PG 67-22
  - Polymer Modified

- Non-tracking Emulsions
Standard Emulsion Specifications

- Anionic Emulsion Specifications
  - AASHTO M 140-8
  - ASTM D 977-05

<table>
<thead>
<tr>
<th>Pen Values 100–200 +</th>
<th>Pen Values 40 – 90</th>
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</thead>
<tbody>
<tr>
<td>RS–1</td>
<td>MS–2h</td>
</tr>
<tr>
<td>RS–2</td>
<td>HFMS–2h</td>
</tr>
<tr>
<td>HFRS–2</td>
<td>SS–1h</td>
</tr>
<tr>
<td>MS–1</td>
<td>HFMS–1</td>
</tr>
<tr>
<td>MS–2</td>
<td>QS–1h</td>
</tr>
<tr>
<td>HFMS–1</td>
<td>HFMS–2</td>
</tr>
<tr>
<td>HFMS–2</td>
<td>HFMS–2S</td>
</tr>
<tr>
<td>SS–1</td>
<td></td>
</tr>
</tbody>
</table>
17 States Known to Allow Reduced Tracking Tack Materials

- Alabama
- Florida
- Georgia
- Illinois
- Louisiana
- Maryland
- Mississippi
- Pennsylvania
- New York
- North Carolina
- Ohio
- Oklahoma
- South Carolina
- Tennessee
- Virginia
- West Virginia
- Texas
Material Selection

• State approved products lists
  • Online at most DOT websites
  • Asphalt Institute State Emulsion Data Base
    • http://www.asphaltinstitute.org/public/engineering/state_binder Specs/emulsion-spec- database.dot
• Material availability
• Local experience
• Dynamic area
Tack Coat
Field Operations
Tack Coat Challenges

• Contractor
  • Application Rate
  • Consistency of Application
  • Tack Coat Pickup or Tracking By Vehicles
  • Traction for Construction Equipment
  • Breaking/Setting Time

• Agency
  • Acceptance
  • Dilution?
  • Application Measurement
  • Bond Quality
  • Tort Claims
  • Pulling Up of Pavement
• Asphalt Institute
  • MS-22 *Construction of Hot Mix Asphalt Pavements, 2nd Edition*

• Comments
  • AI has a long history of promoting the proper use of tack coats.
Manuels of Practice

Current Research

- SHRP II
- Colorado
- Illinois
- Louisiana
- NCAT
- Texas
- Wisconsin
- International
NCHRP Report 712

- Looked at numerous test methods (shear, tension, torsion)
- Many tack materials
- Four application rates (gsy residual)
  - 0.00
  - 0.031
  - 0.062
  - 0.155
- International survey

- Variety of surfaces both AC and PCC
  - New
  - Old
  - Milled
  - Unmilled
  - Dry
  - Wet
  - Clean
  - Dirty

- Eight test temps.
  - -10—60°C
• Recommends Shear Testing
• Stiffer based asphalts performed better
• 0.155 gal/yd² (residual) best results for all materials
• Current common rates may be too light
• Milled surfaces performed better
• Very good training appendix
• Application rate recommendations for different surfaces
## 712 Recommended Application Rates

<table>
<thead>
<tr>
<th>Surface Type</th>
<th>Residual Application Rate (gsy)</th>
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<tbody>
<tr>
<td>New Asphalt</td>
<td>0.035</td>
</tr>
<tr>
<td>Existing Asphalt</td>
<td>0.055</td>
</tr>
<tr>
<td>Milled Asphalt</td>
<td>0.055</td>
</tr>
<tr>
<td>Portland Cement Concrete</td>
<td>0.045</td>
</tr>
</tbody>
</table>
Testing Methods

• Materials
  • Emulsion
  • Paving grade asphalt

• Field/Laboratory Bond Testing
  • Shear Testing
  • Torsion Testing
  • Pull-Off Testing (tension)
  • Cyclic
Best Practices for getting the material on the road!
Best Practices

• Match application to conditions.
  • Materials
  • Residual rate

• Verify application rate.

• Resist tacking too far ahead of paver.
Distributor Truck Setup
Distributor Truck Setup

- Liquid temperature
  - Monitor and Match to material
- Calibrate distributor truck
  - Spray bar height
  - Spray bar pressure
  - Nozzle angle
  - Nozzle selection
  - Thermometers
  - Volumeter
Application Calculations

Student Exercises
### Application of Diluted Emulsion

<table>
<thead>
<tr>
<th>Specified Residual Rate (qsy)</th>
<th>(57% residual emulsion) Application Rate (gsy)</th>
<th>Rate of Dilution with Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1:1*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Appl. Rate</td>
</tr>
<tr>
<td>0.014</td>
<td>0.025</td>
<td>0.50</td>
</tr>
<tr>
<td>0.029</td>
<td>0.05</td>
<td>0.10</td>
</tr>
<tr>
<td>0.043</td>
<td>0.075</td>
<td>0.15</td>
</tr>
</tbody>
</table>

* Dilution Ratios = parts of emulsion : parts of water

- The above stated rates are all at 60°F gallons per sq. yd.
- Application temperatures must be determined and accounted for in order to obtain the exact rate of application
Dilution Allowance Information (NCHRP Report 712)

Allowable Dilution Sites

- Not Allowed
- Supplier's Terminal
- Contractor's Storage Tank
- In the Distributor Tank

Responses
Calculating field application rates

• There are three primary methods of determining field application rates.
  • Determination by volume.
  • Determination by weight or mass.
  • Determination by direct measurement, ASTM D2995

• We will first look at determination by volume.
Direct Measurement using ASTM D2995

Standard Practice for Estimating Application Rate of Bituminous Distributors
Direct Measurement using ASTM D2995

- Field Measurement of Application Rate
  - Longitudinally
  - Transversely
  - Units of Gallons/Yard² (Liters/Meter²)

Photos courtesy of Dr. Louay Mohamad
Critical elements in determining application rates

- Dilution rates are **critical** in determining final application rates.
- Temperature is important in determining accurate volumetric calculated rates.
  - Higher than 60°F, need to spray more emulsion.
  - Lower than 60°F, need to spray less emulsion.
- Uniform application spreads in distributing tack on the surface of the road.
- Samples of emulsion from the spray bar are only good for estimating dilution rates and residual binder properties.
Spray Paver Benefits

• No tracking of the tack
• Better bonding of overlays
  • Increased Overlay life
  • Reduce Rutting
  • Reduce Cracking
• Improved joint compaction
• Easier compaction
Free 4-hour workshop requested through FHWA divisional offices

Questions?