Instructor introductions
Course materials / Forms and handouts
Questions and interaction
Coffee breaks
Classroom etiquette (Cell phones, Talking)

All applications are in terms of residual asphalt.

Opening Remarks

Today’s Participants

- Instructors Introductions
- Audience Makeup?
  - DOT
  - Local Agency
  - Contractor
  - Supplier
  - Consultant
- Years in Industry?
  - 0–5
  - 5–10
  - 10–20
  - 20+

Any preliminary Tack Coat questions?

Overall Purpose
... to improve the overall bonding of pavement layers;
to decrease distresses associated with poor bond;
and to improve overall pavement performance.

Key Factors for Tack Coat Success
- Condition of Existing Pavement
- Tack Coat Application Rate
- Residual Binder Content
- Proper Distributor Operation
- Emulsion Break and Set Times

Workshop Objectives
- Importance of Tack Coats
- Tack Coat Materials Selection & Handling
- Tack Coat Specifications & Manuals
- Quality & Inspection
- Testing & Best Practices
- Review & Summary
Workshop Format

- Guided instruction/discussion
- Protocol:
  - Informal
  - Questions are encouraged
  - Class participation is essential

Learning Objectives

Upon completion of this workshop, you will be able to:
1. Recognize the importance of layer bonding.
2. Describe the proper handling, storage, and testing of tack coat materials.

Learning Objectives (continued)

3. Explain the type of field tests used to measure residual application rates.
4. Identify construction best practices that need to be met in order to have a successful tack coat application.

Tack Coat Workshops

- 2014 – Pilot, VA
- Completed (24)
- Scheduled (1)
- Requested (11)
- Have not Requested (17)
The Ultimate Goal: Uniform, complete, and adequate coverage

I. Importance of Tack Coats

Why do we use Tack Coats?
I. Importance of Tack Coats

- To promote the bond between pavement layers.
- To prevent slippage between pavement layers.
- Vital for structural performance of the pavement.
- All layers working together.
- Apply along all transverse and longitudinal vertical surfaces.

Consequences of Poor Bonding

- Poor pavement performance
  - Slippage cracks
  - Shoving
  - Early fatigue cracking
  - Bottom up
  - Top down
- Costly pavement repairs
  - Repair of isolated area relatively inexpensive
  - Removal and replacement of a portion or the entire pavement structure is very expensive
  - Shorter than expected pavement life can be devastating for agency budgets

Terminology

- **Tack Coat**—sprayed application of asphalt cement upon an existing asphalt or Portland cement concrete pavement prior to an overlay, or between layers of fresh asphalt concrete.
- **Original Emulsion**—an undiluted emulsion which consists of a paving grade binder, water, and an emulsifying agent.
- **Diluted Emulsion**—an emulsion that has additional water.
  - Critical to control
  - 1:1 typical (Original Emulsion: Added Water)

- **Residual Asphalt**—the remaining asphalt after an emulsion has set typically 57–70 percent.
- **Tack Coat Break**—the moment when water separates enough from the asphalt showing a color change from brown to black.
- **Tack Coat Set**—when all the water has evaporated, leaving only the residual asphalt. Some refer to this as completely broken.

So who was listening?

- T/F A Broken Emulsion is the remaining asphalt after an emulsion has set.
Consequences of Debonding

Bonded Demonstration
- Up to 5 sheets (layers)
- 48" x 4" x 11/32"
- 60, 100, or 160 pound loadings
- Various Bonding Configurations

Bonded Demonstration Highlights
- 2 bonded layers had less deflection than 5 unbonded with the same loading (60#).
- 5 unbonded layers deflected 4x more than 5 bonded with the same loading (60#).
- 5 bonded layer with over 2½x the load deflected half as much as 5 unbonded.

TACK

What is going on and why?
- Layer independence
  - Reduced fatigue life
  - Increased rutting
  - Slippage
  - Shoving
- Compaction difficulty

Direction of traffic?
Slippage Failure

Types of Tack Coat Failures

Delamination of overlay from underlying pavement

Days later!

Courtesy of Road Science

Loss of Fatigue Life Examples

- May & King:
  - 10% bond loss = 50% less fatigue life
- Roffe & Chaignon
  - No bond = 60% loss of life
- Brown & 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
So is it worth it to apply a tack coat?

**Cost of Tack Coat**
- **New or Reconstruction**
  - About 0.1–0.2% of Project Total
  - About 1.0–1.5% of Pavement Total Cost
- **Mill and Overlay**
  - About 1.0–2.0% of Project Total
  - About 1.0–2.5% of Pavement Total Cost

Estimated Cost of Bond Failure in Only the Top Lift
- Assume no inflation for materials
- Estimated traffic control
- Used project plans for thicknesses
- Used bid tabs for:
  - Milling
  - Material costs
  - Replaced pavement markings

30–100% of Original Pavement Costs

What is the Risk?

![Graph showing costs](#)

$1500 now or $2 M later?

**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

Successful Application

Proper storing and handling these materials can help ensure proper application and better bonding.
II. Tack Coat Materials Selection & Handling

- Emulsified Asphalts
  - Most common options
    - SS-1, SS-1H
    - CSS-1, CSS-1H
    - RS-1, RS-1H, RS-2
    - CRS-1, CRS-2
    - HFMS-2
    - PMAE
    - Reduced Tracking

Newer Materials

- Materials that have been brought to market in recent years.
- These are primarily reduced tracking emulsion formulations or additives.
- Currently known reduced tracking options found in your handouts.

Material Selection

- State approved products lists
  - Online at most DOT websites
  - Asphalt Institute State Emulsion Data Base
- Material availability
- Local experience
- Dynamic area
Handling of Emulsions

- Do NOT mix anionic and cationic emulsions.
- Vertical tanks preferred—skin formation.
- Protect from freezing.
- Avoid overheating—typically <180°F.
- Minimal low-shear pumping.

Consult with the Supplier for any unique handling needs for their product(s)!

Handling of Hot AC

- Proper personal protective equipment.
- Proper protection of hot elements.
- Ensure a water-free distributor.

Asphalt Institute Burn Information

Storage Options

- Tank—long-term storage
- Tanker—short-term storage
- Distributor Truck—short-term storage
Storage Tanks
- Long-term storage.
- Vertical generally preferred.
- Heated.
  - Store toward lowest pumpable temperature
- Agitation.
  - Low-shear
  - Minimize frequency
- Hoses.
  - Keep clean

Tanker Storage
- Short-term storage.
- Generally not heated.
- Generally can not agitate.

Distributor Storage
- Short-term storage
- Heated
- Pump circulation

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III. Tack Coat Specifications & Manuals
Negatively-Charged Emulsions are classified into 3 main types:

- RS (Rapid Setting)
- MS (Medium Setting)
- SS (Slow Setting)

Positively-Charged Emulsions are also classified into 3 main types:

- CRS (Rapid Setting)
- CMS (Medium Setting)
- CSS (Slow Setting)
Emulsions are asphalt droplets suspended in water
- Breaking
  - Contact with surface changes pH; reducing charge
- Setting
  - Evaporation leads to coalescence
  - Original asphalt characteristics return

Standard Emulsion Specifications

- Anionic Emulsion Specifications
  - AASHTO M 140-08
  - ASTM D 977-05

<table>
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<tr>
<th>Pen Values 100-200 +</th>
<th>Pen Values 40 – 90</th>
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<tr>
<td>RS-1</td>
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<tr>
<td>MS-1</td>
<td>MS-2</td>
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- Cationic Emulsion Specifications
  - AASHTO M 208-01
  - ASTM D 2397-02

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<td>CMS-2</td>
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<td>CSS-1</td>
<td>QQS-1h</td>
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Cutback Asphalt Specifications

AASHTO M 81 & 82
ASTM D 2027

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<th>Rapid Cure Characteristics</th>
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<td>Residue after Distillation</td>
<td>55 +</td>
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<td>Penetration, 77°F, 100 g, 5s</td>
<td>80 – 120</td>
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<tr>
<td>Penetration, 77°F, 100 g, 5s</td>
<td>120-250</td>
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</table>

Additional Nomenclature

QS = Quick Set
HF = High Float
1 = Binder residue = 60% Min. (Low Viscosity Emulsion)
2 = Binder Residue = 65% Min. (High Viscosity Emulsion)
H = Hard Pen Asphalt Base
S = Soft Pen Asphalt Base or sometimes Solvent
L and/or P = Latex and/or Polyserm

State Non–Tracking Specifications

- State specifications tend to mirror manufacturer’s specifications.
- States generally have an approval process for new products.
- Need to be on Approved Products List.
- Example Virginia:
  - Six approved products
  - Each product’s specifications from supplier
Manuals of Practice

- 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.

Comments

- Tack Coat Guidelines, Caltrans (2009)
- Tack Coats: How and what to apply! Colorado Asphalt Pavement Association (CAPA) (2011)

Current Research

- NCHRP 9-40a
- SHRP2
- Arkansas
- Colorado
- Illinois
- Louisiana
- NCAT
- Texas
- Wisconsin
- Oregon
- MnRoads
- 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
  - Un-milled
  - Dry
  - Wet
  - Clean
  - Dirty
- Eight test temps. -10—60°C

NCHRP Report 712 Conclusions

- 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

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Uniformity of the Tack Coat Application

- Non-uniform Application
- Proper Application

Residual Asphalt Binder in Emulsion

- Slow set tack coat = 67% asphalt + 33% water
- Generally, use this ratio to estimate residual asphalt.
- Residual asphalt is critical: It is the amount of actual asphalt that remains on the pavement after water and solvents have evaporated.

Calculation of Application Rate for Emulsion

- Based on a ratio of 2/3 asphalt and 1/3 water, the required application amount of asphalt binder in an asphalt emulsion will be 1.5 times greater than the residual amount.
- Application Rate = 1.5 x Desire Residual Asphalt

Application Rate for Diluted Emulsion

- Based on a ratio of 1 part asphalt emulsion and 1 part additional water, a diluted asphalt emulsion will have a residual binder content of only 1/3 of the weight of the emulsion.
- So, you must apply three times (3x) more diluted emulsion than the desired residual tack coat rate.
Critical Elements in Determining Residual Application Rates

- Dilution rates are critical in determining final residual 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.
Correcting for temperature

- Asphalt and water expands and contracts when temperatures deviate from 60°F.
- As temperatures rise above 60°F expansion occurs and the resulting density (#/gal.) decreases.
- As temperatures cool below 60°F contraction occurs and the density increases.
- A Temperature–Volume correction table for asphalt emulsion is available in MS–19, page 91.

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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

Application Verification (NCHRP Report 712)

- The rate of material applied is calculated by determining the volume of material distributed. Either by:
  - By observation and recordation of an onboard volume meter or gauge.
  - Or, Using a tank stick method where the depth of material is measured in the tank and the volume is calculated or by the use of a pre-calibrated stick.

Dipstick Method

- Measure Asphalt Volume in Truck
- Record Asphalt Temperature
- Spray Tack Coat Over a Known Area
- Measure Asphalt Volume in Truck
- Correct Volume for Temperature Variation from 60°F

Before checking your volume by sticking the tank, make sure Distributor is level.
**Dipstick Equation:**

\[
\frac{9 \times \text{Gallons Applied}}{\text{Width} \times \text{Length}} \quad \text{(feet)} \times \text{(feet)}
\]

Note: 9 to convert from square feet to square yards. Use as required.

**Calculating rates by Volume**

- When using a tank volume method for determining the quantity of material distributed, the temperature **must** be determined and the volume of material corrected to 60°F.

- Let's work an Example Problem

**Determining Residual Application Rates**

- For the following examples we will assume we are using SS-1h or CSS-1h which have a minimum AASHTO (M140 and M 208 resp.) specified minimum residual asphalt content of 57%.

- Specifying a 60°F undiluted emulsion rate, will yield the following in-place residual asphalt content in gallons per square yard (gsy).

**Exercise: Calculating rates by Volume**

- Distance travelled: 5600 ft. – 3500 ft. = 2100 ft.
- Area sprayed: \( \frac{2100 \text{ ft.} \times 14 \text{ ft.}}{9 \text{ sq. ft.}/\text{sq. yd.}} = 3267 \text{ sq. yd.} \)

- Hot Gallons sprayed: 1875 gal - 1250 gal = 625 gal @ 160°F

- Temp. Correction factor from Chart: 0.97500

- 60°F gallons: \( 625 \text{ gal} \times 0.9750 = 609 \text{ gal} \)

- 609 diluted gallons!

- SS-1h Emulsion is diluted 1:1

- Calculate the residual application rate

**Calculating rates by Volume Solution**

- Distance travelled:
- Area sprayed:
- Hot Gallons sprayed:
- Temp. Correction factor from Chart:
- 60°F gallons:
Comments on Calculating by Volume

- **Pros:**
  - Quick
  - Simple
  - Accuracy improves with larger areas

- **Cons:**
  - Volume requires Dip Stick, or Volumeter
  - Dilution rate vital
  - Temperature correction required
  - Inaccurate on small areas

Calculating rates by Weight (Mass)

- Calculating an application rate by weight is the most accurate method.
- Bill of lading from the supplier should contain a 60°F wt. per gallon.
- Weight measurements are not affected by temperature.
- However constant weighing after each shot can be complicated.
- Recommend using this method for full load applications, calibration, etc.

Weight

![Weight Diagram](image)

Exercise: Calculating rates by Weight (Mass)

- Plans specify CSS-1h (57% residue)
- Tare Weight of empty distributor = 26,000 lbs.
- Loaded weight of distributor (1:1) = 54,000 lbs.
- Bill of lading shows a 60°F density of 8.350 #/gal
- Application width = 15 feet
- Application length = 3 miles

Calculate the residual application rate in lbs/yd²

Calculating rates by Weight (Mass) Solution

- **Step 1:** Determine pounds of diluted emulsion applied. Beginning weight - ending weight
  
  54,000# - 26,000# =

- **Step 2:** Account for dilution if present, For our problem, 1:1 dilution of Original Emulsion and Water
  
  ∴ 28,000#/2 =

- **Step 3:** Calculate residual asphalt weight. 57% residue in Original Emulsion
  
  14,000# X 0.57 =

- **Step 4:** Calculate application area. Length X Width
  
  (3 mi. X 5,280 ft./mi.) X 15 ft. =

- **Step 5:** Convert to square yards.
  
  237,600 ft² ÷ 9 ft²/yd² =

- **Step 6:** Calculate Residual Asphalt application rate.
  
  Mass Applied ÷ Area Applied
  
  7,980#/ 26,400 yd² =
Calculating rates by Weight (Mass) Solution

NOTE: If one wanted to know the residual application in gal./yd.\(^2\) use 8.350 #/gal from the Bill of Lading.

\[
0.30 \text{ #/yd.}^2 \div 8.350 \text{ #/gal} =
\]

Comments on Calculating by Mass

- **Pros:**
  - Quick
  - Simple
  - Temperature correction not needed
  - Accuracy improves with larger areas

- **Cons:**
  - Dilution rate vital
  - Inaccurate on small and irregular areas

Direct Measurement using ASTM D2995

- **Field Measurement of Application Rate**
  - Longitudinally
  - Transversely
  - Units of Gallons/Yard\(^2\) (Liters/Meter\(^2\))

- **Method A—Weighing Pads**
  - Pre-weigh pads
  - Secure pads to surface
  - Apply tack coat
  - Reweigh pads
  - Calculate application rate

Direct Measurement using ASTM D2995

**Standard Practice for Estimating Application Rate of Bituminous Distributors**

Photo courtesy of Dr. Louay Mohammad
Direct Measurement using ASTM D2995

- Method B—Volume-Based Calculations
  - Spray tack coat into containers for a set time period
  - Determine volume collected for each nozzle
  - Calculate transverse uniformity
  - Calculate longitudinal rate incorporating truck’s velocity

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<thead>
<tr>
<th>Location</th>
<th>Application Rate</th>
<th>Residual Rate</th>
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<tr>
<td>Left Wheel Path</td>
<td>0.075</td>
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<tr>
<td>Center of Lane</td>
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<td>0.032</td>
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</table>

Pros:
- Quick
- Simple
- Temperature correction not needed
- Allows for randomized testing
- Measures across the bar

Cons:
- Dilution rate vital
- More labor intensive than other options
- Potential evaporation between application of emulsion and reweighing of pads

Inconsistent Application

Comments on Calculating by ASTM D2995

Time for a quick Break?

15 Minute Break
V. Testing & Best Practices

- Materials
  - Emulsion
  - Paving grade asphalt
- Calibration of Distributor Truck
- Field/Laboratory Bond Testing
  - Shear Testing
  - Torsion Testing
  - Pull-Off Testing (tension)
  - Cyclic

Typical Emulsion Tests

- Viscosity, Saybolt Furol @ 77°F
- Sieve Test, %
- Storage Stability, 24 hrs, %
- Unit Weight @ 77°F, lbs/gal
- Residue by distillation to XX°F (Note: states commonly choose 300–400°F)
- Pen @ 77°F on Residue, 0.1 mm
- Ductility @ 77°F on Residue, cm
- Solubility on Residue, %

Shear Testing

- Cores or Lab Specimens
  - 4 or 6–inch
  - Common for Product Approval
- Virginia Example
  - Four-inch core or specimens
  - Placed in shear head
  - Tested on Marshall Stability Unit
  - 2 inches per minute of movement
  - Tested at 70°F
  - Record maximum load on each of three tests
  - 100 psi minimum average–none < 50 psi (milled)
  - 50 psi min average–none < 30 psi (non–milled)
Torsion Example
- Developed in Sweden
- Commonly used in the United Kingdom
- Known as the “Torque Bond Test”
- Manual and automated versions
- Is being used for product approval in US
- Field or laboratory test
- Various configurations

Tension Testing
- Most typically a field test
- May be a modified ACI-503 or
- Direct Tensile Bond Test: ASTM C-1583
- Procedures identified in Texas, Kansas, and Virginia
- AASHTO TP 91-11
  - Asphalt Bond Strength Test
  - Lab tension test

Tension Testing
- Virginia Example
  - Lab test @ 70°F
  - Four-inch specimen
  - Apply pre-load of 10 lbs.
  - Load at 1200 lbs. per minute until failure
  - Calculate strength in psi
  - 40 psi minimum average—none <20 psi (milled)
  - 30 psi min average—none <20 psi (non-milled)

Cyclic Loading Testing
- Repeated Load Test
- Shear, Tension, and Torsion Options
- Example: Composite Specimen Interface Cracking (CSIC) Test
  - Developed in Florida
  - Tension Test
  - Monotonic or Cyclic Procedures

CSIC
- Cyclic Methodology
  - Prepare Specimens
  - One Second Cycles
    - Load to chosen peak load
    - Remove load
    - Rest
    - Repeat
  - Calculate Cycles to Failure
  - Calculate Crack Propagation Rate

Comments on Testing Options
- Shear Testing
  - Lab test
  - Quick
  - Repeatable
  - Most widely promoted
  - Uses common lab equipment
  - Cleanly ranks materials
- Torsional Testing
  - Lab or field test
  - Quick
  - Poorer repeatability (manually run)
- Tension Testing
  - Lab or field test
  - Quick
  - Repeatable
  - Cleanly ranks materials Used in Texas, Kansas, and Virginia
- Cyclic Testing
  - Lab test
  - More time consuming
  - Repeatable
  - Cleanly ranks materials
Comments on Testing Options

- Testing Method has a Huge Effect on Rankings
  - Shear/Torsion vs. Tension/Cyclic
  - Stiffer vs. Softer Materials

Confused?

Surface Preparation

- Milling
  - Improves profile
  - Typically improves bonding characteristics
  - Increases cleaning effort
  - Adds cost
- Surface Sweeping
- Visually Verify Moisture Free

Best Practices

- Surfaces need to be clean and dry
- Uniform application
- Tack all surfaces
  - Horizontal
  - Vertical

Best Practices

- Match application to conditions.
  - Materials
  - Residual rate
- Verify application rate.
- Resist tacking too far ahead of paver.
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

What Happened Here?

Spray Bar

Triple Lap Coverage

12"
Consult with distributor truck manufacturer to match the material to the nozzle.

ONE SIZE DOES NOT FIT ALL

Nozzles are clogged, but triple overlap covering the gap.

Note: not a tack coat, but principle applies.
Cleaning Distributor Tank

- Critical when changing from one product to another
- Significant safety hazard can occur
- Product quality can be affected
- Best Practice is to empty the tank and clean if necessary.

Key Items for Inspectors

- Check truck setup.
  - Spray bar height (~12"")
  - Appropriate nozzles
  - Nozzle orientation (15–30°)
  - Check application rate gauge in truck
  - Check application temperature
- Collect samples.

- Know the desired application and residual rates.
- Visually inspect application
- Verify application.
  - Volume
  - Mass
  - ASTM D2995

Tack Coat Application

Generally Uniform Application

Missed Line

Filling it in
 Spray Pavers/Bonded Overlays
  - Spray Paver–Single Pass Paving and Sealing
    - Hot mix asphalt overlay
    - Polymer modified emulsion tack
    - Placed with spray paver
      - Paver & Distributor
      - High Application Rates
        - 0.08–0.20 gsy residual
  - Examples
    - BondTekk®—bonded overlay
    - Novachip®—thin bonded overlay

Vögele: Spray Jet attachment
Roadtec: SP 200 Spray Paver
Limited Number of States Specifying
Developed in Europe
Specialty Product–Using a Standard Distributor
  - UltraFuse Bond Coat (not an emulsion)
Vögele: Spray Jet

Purported Spray Paver Benefits
- No tracking of the tack
- Better bonding of overlays
  - Increased Overlay life
  - Reduce Rutting
  - Reduce Cracking
- Improved joint compaction
- Easier compaction

Example Specifications
- Utah and Kansas
- “Self-Priming Paver”
  - Hopper
  - Asphalt emulsion storage tank
  - System for measuring application volume
  - Spray bar
  - Heated, variable width screed
- Material Transfer Vehicle Required

Workshop Objectives
- Importance of Tack Coats
- Tack Coat Materials Selection & Handling
- Tack Coat Specifications & Manuals
- Quality & Inspection
- Testing & Best Practices
- Review & Summary
VI. Review and Summary

(Experts commonly disagree)

Common Tack Coat Questions

- “Do I still need to tack…”
  - Milled Surface
  - “Fresh” Pavement
  - Late season/cooler days

- This workshop recommends tacking all surfaces

Example of Emulsion Break

Unbroken Emulsion

After Breaking

Common Tack Coat Questions

- “When can I pave on the emulsion?”
  - Has it Broke?
  - Does it need to be Set?
  - Fresh—spray pavers

- We recommend paving begin after the emulsion has broke.
  NOTE: Spray pavers and their emulsions are an engineered system that are designed to perform without the emulsion breaking.

Common Tack Coat Questions

- What is the Optimal Application Rate?
  - Surface Type
  - Surface Condition
  - Workshop Recommended Ranges

<table>
<thead>
<tr>
<th>Surface Type</th>
<th>Residual Rate (gpy)</th>
<th>Appx. Bar Rate Undiluted* (gpy)</th>
<th>Appx. Bar Rate Diluted 1:1* (gpy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Asphalt</td>
<td>0.020 - 0.045</td>
<td>0.030 - 0.065</td>
<td>0.060 - 0.130</td>
</tr>
<tr>
<td>Existing Asphalt</td>
<td>0.040 - 0.070</td>
<td>0.060 - 0.105</td>
<td>0.120 - 0.210</td>
</tr>
<tr>
<td>Milled Surface</td>
<td>0.040 - 0.080</td>
<td>0.060 - 0.120</td>
<td>0.120 - 0.240</td>
</tr>
<tr>
<td>Portland Cement Concrete</td>
<td>0.030 - 0.050</td>
<td>0.045 - 0.075</td>
<td>0.090 - 0.150</td>
</tr>
</tbody>
</table>

*Assume emulsion is 33% water and 67% asphalt.

Common Tack Coat Questions

- When to Re-Tack?
  - Tracking
  - Contamination

If in doubt … Re-Tack
To Dilute or Not Dilute

**Rule No. 1 – Follow the Golden Rule**

(Contract Specifications)

- Should tack be diluted? – Depends on Rate
- Distributors tend to get more uniform coverage with a greater shot rate. (0.10 g/sq.yd. or more)

<table>
<thead>
<tr>
<th>Surface</th>
<th>Resid</th>
<th>Emulsion</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Asphalt</td>
<td>0.020</td>
<td>0.045</td>
</tr>
<tr>
<td>Milled Surface</td>
<td>0.040</td>
<td>0.080</td>
</tr>
</tbody>
</table>

- If 0.02 Resid ≈ 0.03 emulsion then Dilute 1:3 – 0.12 Tot. Diluted Rate
- If 0.08 Resid ≈ 0.13 emulsion then No Dilution may be required

Monitoring Dilution

- Verify dilution amount
- Dilution cannot be used to “stretch” tack
- Residual value is key.

This Workshop recommends dilution by supplier only.

Common Tack Coat Questions

- **What Type of Bond Testing?**
  - Shear
  - Torsion
  - Pull off
  - Cyclic
- All have advantages and disadvantages
- Further research and acceptance will likely lead to a generally preferred method.

Areas of Known Agreement

- **Layer Bonding is Vital**
- **Surface Preparation**
  - Clean
  - Dry
- **Milling Improves Field Performance**
  - Shear
  - Cleaning

Areas of Known Agreement

- **Application Quality Vital**
  - Proper Rate
  - Consistency
- **Distributor Truck**
  - Setup
  - Calibration/Verification
  - Maintenance
- **Tacking of Longitudinal Joints**
  - Bonding
  - Confinement
- **Excessive Tack is Bad**

Areas of Known Agreement

- **Tack Coat Rate Depends on Surface Condition**
  - Fresh
  - Weathered
  - Raveled
  - Milled
- **Need for Research**
  - Field Performance
  - Field Testing
  - Bond strength
  - Application amount
- **Treat Tack as Separate Pay Item vs. Incidental Item**
Learning Objectives
Upon completion of this workshop, you will be able to:
1. Recognize the importance of layer bonding.
2. Describe the proper handling, storage, and testing of tack coat materials.
3. Explain the type of field tests used to measure residual application rates.
4. Identify construction best practices that need to be met in order to have a successful tack coat application.

Questions?

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Jason Dietz – FHWA Resource Center

Thank You!