Tack Coats Today…and in the future

Ontario’s New Non-Tracking Tack Coat
SS-1 and SS-1HH - CLEAN BOND COAT (CBC)

ORBA / OAPC Partners in Quality 2017

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Tack Coats - Outline

• Defined
• Why use them
• When to use them
• Evolution- Equipment
• The Good, The Bad, The Ugly
• De-bonding, Slippage, Fatigue
• New Non-Tracking Tack (Clean Bond Coat-CBC)
• Application Guidelines
• Handling and Storage Guidelines
• Future Research and Innovation
• Other Uses for CBC
• Other New Product- Contractor/Owner Opportunity
What is Tack Coat?

- **Tack** is a light spray application of an *asphalt emulsion* to promote a solid bond between the existing pavement layer and the new overlay.
- Prevents delamination/de-bonding, slippage and *enhances structural performance*.
Why Tack Coat?

- IMPORTANT! Bonds HMA layers together
- Vital for structure performance
- Gives maximum strength to pavement structure providing a monolithic layer - All layers working together
- Prevents delamination, and slippage between HMA/Pavement layers and mitigates fatigue damage
- Helps improve density due to less slippage during rolling of HMA (when cured)
- Ensures long term performance of HMA
When to Tack?

- ALWAYS!
- Especially with thin lift pavements
- Big or small jobs
- Very cost effective

So...Why Not Tack?
Why NOT Tack Coat and Common Misconceptions and Perceptions...

- Pain in the B*@#$
- Not my job
- We never do it on jobs like this
- We don’t have the right crew or equipment
- We can’t afford to
- It just makes a mess
- The job is too remote
- Nobody will know the difference
- Not sure that it really does anything
- It’s too sticky

• THE REALITY IS...YOU CAN’T AFFORD NOT TO!
New Computerized Distributors
600 Gallon Spray Unit
200 Gallon Hand Sprayer Unit
Simple Drum Pump

Better than nothing...more difficult to gauge application rate but always possible
Delamination
(De-bonding)
No Glue!!

Days later!

Courtesy of Road Science
Extreme Delamination/de-bonding
Milling Operation Exposes Non-Bonded HMA Layers

Mill down into next lift
Pavement Behavior

Shear Transfer?

Load Distributed by Tire

Stress Distribution

Tension

Compression

Aggregate Base

Soil Subgrade

Pavement Behavior

Compression

Tension

Aggregate Base

Soil Subgrade

 Courtesy of Rich May
Consequences of De-bonding

About a 50% Increase In Microstrains When Unbonded

Courtesy of NCAT
Bonded Strength Demonstration

½” Deflection, 60lb Load

¼” Deflection, 160lb Load

Un-bonded

Fully Bonded
Bonded Strength Demonstration

• Highlights
• 5 un-bonded layers deflected 4x more than 5 bonded with the same loading.
• 2 bonded layers had less deflection than 5 un-bonded with the same loading.
• 5 bonded layers with over 2½ x the load deflected half as much as 5 un-bonded.
Consequences of Poor Bonding

• Layer independence
  • Reduced fatigue life
  • Increased rutting
• Slippage
• Shoving
• Compaction difficulty

Direction of traffic?

Typically appears in braking areas, high speed curves or where sharp turning movements occur.
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

Simply demonstrates that with even minor losses in bonding, the effect is very significant.
8 – 10 years (est.) USA Interstate Pavement
Cores Showing De-bonding

Bonding Failures

Courtesy of MODOT
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
Best Practices

• Surfaces need to be clean and dry.

• Uniform application.

• All surfaces are tacked.

• Tack should not be tracked off the road.
  o New Non-Tracking Tacks Address This Problem (CBC)
Proper Cleaning

Second Sweeper Pass

Joints need to be dry and clean
Don’t Pave Beyond Tacked Surface
Homogenous Tack Coat - CBC
Proper use of Tack Coat (using SS-1HH/CBC)

The Good
Worst Practices

The Bad
The Bad
The Bad
Ontario’s SS-1and SS-1HH Tack Coats

**SS-1** – Conventional Ontario Tack Coat

**SS-1HH** – New Non-Tracking Tack Coat

- Harder Pen Grade Base Asphalt
- Similar Softening Point
- Enhanced Break, Set, Cure Time
- Slight Premium
- Follow Application, Handling and Storing Guidelines
- Ensure it’s tested to SS-1HH specification
Non-Tracking Tack- SS-1HH (CBC)
Break, Set, Cure... Be Patient

The key is to clean the surface and let it cure for best results.
Non-Tracking Tack- SS-1HH (rain)
Tapers for mid-job joint-added aggregate
Prep for next day joint
Application rates and Temperatures
Application Rates and Temps

NON-TRACKING TACK COAT- (SS-1HH)
• CBC (NON DILUTE)
  • CLEAN DRY MILLED SURFACE – TARGET 0.18 – 0.36 L/M2
• CBC (Dilute) (50/50)
  • CLEAN DRY MILLED SURFACE - 0.25 - 0.70 L/M2

SURFACE CONDITIONS WILL DETERMINE OPTIMAL APPLICATION RATE

APPLY BETWEEN 70°C - 80°C/82°C/… (Some go as low as 60°C)

HEAT HELPS IT SPRAY, ENSURES OPTIMUM COVERAGE AND PROMOTES QUICKER BREAK, SET, CURE
## What is the Optimal Application Rate?

### By Surface Type

### By Surface Condition

<table>
<thead>
<tr>
<th>Surface Type</th>
<th>Residual Rate (L/m²)</th>
<th>Approx. Bar Rate Undiluted* (L/m²)</th>
<th>Approx. Bar Rate Diluted 1:1* (L/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Asphalt</td>
<td>0.090 – 0.200</td>
<td>0.150 – 0.340</td>
<td>0.300 – 0.680</td>
</tr>
<tr>
<td>Existing Asphalt</td>
<td>0.180 – 0.320</td>
<td>0.300 – 0.530</td>
<td>0.600 – 1.060</td>
</tr>
<tr>
<td>Milled Surface</td>
<td>0.180 – 0.360</td>
<td>0.300 – 0.600</td>
<td>0.600 – 1.200</td>
</tr>
<tr>
<td>Portland Cement Concrete</td>
<td>0.140 – 0.230</td>
<td>0.225 – 0.380</td>
<td>0.450 – 0.760</td>
</tr>
</tbody>
</table>
Key Items for Inspectors

- Check truck setup.
  - Spray bar height (~300 mm)
- 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
Common Tack Coat Questions

When to Re-Tack?
• Tracking
• Contamination
Re-Tack when in doubt.

Is Dilution okay?
• Follow MTO/OPSS specs
• Verify dilution amount

CAUTION
Cannot be used to “stretch” tack as residual value is key.

Suppliers can dilute.
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
CBC- Application Guidelines

• PRIOR TO APPLICATION HEAT AND CIRCULATE MATERIAL

1. HEAT TO 60-80 C… ALTHOUGH 70-80 IS OPTIMAL
2. CIRCULATE MATERIAL IN DISTRIBUTOR
3. ONCE TEMP IS REACHED CIRCULATE DISTRIBUTORS SPRAY BAR
4. MAINTAIN CIRCULATION THROUGH SPRAY BAR (30 MIN) THEN APPLY

** INTERMITTENT APPLICATIONS SLOW CONTINUOUS CIRCULATION THROUGH SPRAY BAR UNTIL PAVING FOR DAY IS COMPLETE**
CBC – Application Guidelines

• CAN BE APPLIED TO ANY PAVEMENT TEMP THAT CONVENTIONAL TACK COATS ARE ALLOWED.

• DESIRED APPLICATION TEMP IS 60-80°C FOR SUNNY DAYS

• UPPER END OF RANGE ON CLOUDY AND SHADY LOCATIONS

• DO NOT BOIL OR FREEZE

• OVERHEATING WILL DAMAGE PRODUCT
CBC- Storage and Handling

ALWAYS PLACE ALL EMULSIONS IN CLEAN STORAGE TANKS

• CONTAMINATION COULD REDUCE PERFORMANCE

STORAGE IN TANKER TRAILERS

• SHOULD NOT EXCEED 1 WEEK

• IF EXCEEDING 1 WEEK STORAGE- CIRCULATE TWICE PER DAY FOR MINIMUM 20 MIN
CBC- Storage and Handling

STORAGE IN VERTICLE TANKS

• RECOMMENDED – SURFACE AREA
• AGITATION TO PREVENT “SKINNING”
  • GENTLE ROLL ON TOP
    • 11 REVOLUTIONS PER MIN
• FILL FROM BOTTOM PREFERED
• TEMP = 70 to 80C
• ALWAYS KEEP HEATING ELEMENTS FULLY COVERED WITH PRODUCT

DO NOT BOIL OR ALLOW TO FREEZE
Manufacturers Recommendations

RECOMMEND ADJUSTING FOR FIELD CONDITIONS

• TEMPERATURES
• SURFACE WILL DICTATE SPRAY RATES
• SHADE, SUN, IMMINENT RAIN, COOL or COLD TEMPS

SOLID UNIFORM APPLICATION

• USE OF DISTRIBUTORS OR EQUIPMENT WITH SPRAY BARS IS OPTIMAL

PROPER FIELD PREPERATION IS REQUIRED

• USE CALIBRATED EQUIPMENT
Future of Tack Coats

• Need for Research
  • Bond strength and application amount
  • Field Performance
  • Field Testing
  • Lab Testing,

• Sharing of information
Future Tack Coat Innovations

• Polymer modified emulsions

• Provide superior bonds in high stress areas

• Night work – Spray ahead if possible

• Two component tack coats

• Integrated spreader and distributor
Conclusions

• **DO IT RIGHT!!!**

• Uniform application
• Choose the correct rate
• Proper Equipment Selection
• Clean dry pavements
• Allow tack to break/set/cure prior to placing HMA
• Ensure testing companies know the difference between SS-1 and SS-1HH and dilute or non-dilute emulsions

• Minimum cost is <4% /cost of one lift of HMA
Alternative use of CBC Non-Tracking Tack
CIREAM FOG

CBC held CIREAM together for 2 weeks before HMA was applied...
Stewart Hill Rd NS
Fog Coat - East Ferris on ST (before)
CBC- SS-1HH/Non-Tracking Tack Fog Coat
CBC/SS-1HH/Non-Tracking Tack Fog Coat
CBC/SS-1HH/Non-Tracking Tack Fog Coat
Fog Coat Complete - East Ferris on ST
Fog Coat Complete- East Ferris
Fog Coat- East Ferris on Oxidized HMA
Application Rates and Temps

FOG SEAL

- USE OVER GRADED SEAL OR OXIDIZED ASPHALT
- DILUTE 50/50
- APPLY 0.45 - 0.8 L/M2
- FIELD ADJUST ACCORDINGLY
- APPLY BETWEEN 60-80C
Application Rates and Temps

DUST CONTROL

• USE OVER GRADED SEAL OR OXIDIZED ASPHALT

• DILUTE 50/50

• APPLY 0.45-2.25 L/M2

• FIELD ADJUST ACCORDINGLY

• APPLY BETWEEN 60-80C
NEW Mastic Repairs

Lack of bond = Up to 75% decrease in pavement life
NEW Mastic Repairs

Mastics can be used for wider and deeper cracks- they are composed of both high performance cold mix and crack sealant systems
NEW Mastic Repairs
QUESTIONS?

THANK YOU!