Note from the author:
During the discussion period following the presentation, comments were made regarding the practice of paving on unbroken or uncured tack coat. This subject was not addressed explicitly in the presentation, and the author wishes to make the following comments:

- Unbroken/uncured tack coat is the main reason for pick up and tracking of tack coat asphalt by truck and paver tires.

- In several documents referenced when preparing for this presentation, it was reported that in both laboratory and field studies the measured bond strength is greater when the tack coat is allowed to cure. The bond strength increased with curing time.

- There is a lot of controversy in the industry regarding paving on unbroken tack coat. While this practice may be used in some places, it lends itself to scrutiny and further investigation by each agency before such practice is considered locally acceptable. There are definite risks associated with this approach, including possibly trapping water in the asphalt concrete near the bond, and therefore potentially weakening the long term bond strength, and making the mix susceptible to moisture damage. This may not be as big of a problem in open-graded asphalt mixes such as SMA, where the opportunity for the water to evaporate is greater than in a dense-graded asphalt mat.

- To the author’s knowledge, there have not been any studies reported recently which prove that paving on unbroken or uncured tack coat results in a pavement layer bond that is equally as strong as when the tack coat is allowed to cure.

Sincerely, Ania Anthony
Tack Coats for Asphalt Paving

Saskatchewan Highways Perspective

Director, Road Sciences and Environment
Technical Standards Branch

The CTEP/APWA Western Canada Pavement Workshop
Feb 8, 2017
Tack Coat is the glue for asphalt

Bonded layers are stronger together
Bonding prevents slippage
All layers carry loads
ESSENTIAL FOR LONG TERM PERFORMANCE
Some important asphalt quality items

- Aggregate
- Gradation
- Asphalt Content
- Air voids
- Asphalt cement type
- VMA
- Compaction
- Smoothness
- Layer Thickness
- Film Thickness
- Dust to Binder Ratio
- Specific Gravity
- Stripping Resistance
- Stability and Flow
- Moisture Content

Challenging to stay on top of all of these ...

GOOD JOB!!!
Quality of Tack Coat?

IT'S "GOOD ENOUGH"...
Effects of bonded layers

11 sheets of ply-wood, approx. 60 lb load
Deflection 21 times greater when un-bonded
Effects of bonded layers

Unbonded

Fully Bonded

Reproduced with permission from the Asphalt Institute
When bonding is poor...
Hidden bond failures...
Shorter pavement life!
Poor bond means 50-75% loss of life
Asphalt Institute reports the following:

1-1.5% total cost of pavement

Applying Tack Coat

Bond Failure

30-100% total cost of pavement
Consequences of poor bond (NCAT)

Top layer carries more load

Original image from NCAT, published in Roads and Bridges magazine “A tack for the battle”
State of practice in Canada
(TAC 2015 roundtable: five provinces, one city)

| Products Used                  | • SS-1, MS-1 are main products in the West  
|                               | • Quebec uses cationic (CRS-1)  
|                               | • Some still allow cutbacks  
|                               | • Some allow dilution, some do not  |
| Application Rates             | • Sometimes prescribed  
|                               | • Not measured directly on road (volume/area only)  |
| Ensuring Good Bond            | • Bond strength measured by Quebec only  
|                               | • Weather limits prescribed sometimes  |
| Level of Satisfaction         | • Quebec has good bonds since testing added  
|                               | • Tracking and pick up are a problem for most  
|                               | • Uniform application sometimes of concern  |
When to tack?
How much is enough?
Which product is best?
Recommended Tack Coat Practice
(NCHRP 712 and Asphalt Institute)

- All surfaces need a tack coat
- Have tack coat as bid item (measure)
- Use recommended application rates
- Use shear strength to measure bond quality
Recommended Tack Coat Practice
(NCHRP 712)

Recommended Application Rates

<table>
<thead>
<tr>
<th>Surface Type</th>
<th>Residual Application Rate (l/m²)</th>
<th>SS-1 Undiluted Application Rate (l/m²) assuming 60% residual</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Asphalt Mixture</td>
<td>0.16</td>
<td>0.27</td>
</tr>
<tr>
<td>Old Asphalt Mixture</td>
<td>0.25</td>
<td>0.42</td>
</tr>
<tr>
<td>Milled Asphalt Mixture</td>
<td>0.25</td>
<td>0.42</td>
</tr>
<tr>
<td>Portland Cement Concrete</td>
<td>0.20</td>
<td>0.33</td>
</tr>
</tbody>
</table>

Results of NCHRP 712 bond strength testing:
- SS-1h performed better than SS-1
- CRS-1 performed worst
- Better bond strength with higher viscosity products
- Better bond strength with longer curing time of tack coat
SMHI Specifications

• Tack coat is a bid item ($ per tonne)
• Specifications require SS-1 (or SS-1h – just added, not tired yet) to be diluted with equal amount of water
  – Some Contractors do not dilute
  – Some Contractors dilute by adding 20 – 50% water
• SS-1 temperature at application 25 – 55°C
• Distributor must be calibrated
  – Not done on site
SMHI Specifications

- Application rate as required by Engineer
  - Coverage not specified (ex. min. 95% etc.)
  - Rates vary, and usually lower than NCHRP 712
- Pavement surface min. 2°C
- Weather not misty or rainy, no impending rain
- Surface must be clean and dry
...recently added to SK EPS Asphalt Concrete

1.1 In addition to Specification 4000.3.4.2, the tack coat shall be applied in accordance with the application rates outlined in the following table:

<table>
<thead>
<tr>
<th>Surface Type</th>
<th>Application Rate (L/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Residual</td>
</tr>
<tr>
<td>Oxidized Asphalt Concrete</td>
<td>0.18 – 0.27</td>
</tr>
<tr>
<td>Milled Asphalt Concrete</td>
<td>0.27 – 0.36</td>
</tr>
<tr>
<td>New Asphalt Concrete</td>
<td>0.14 – 0.18</td>
</tr>
</tbody>
</table>

1.1.1 Potable water shall be used to dilute the emulsified asphalt.
SMHI Spec: Tack Coat Quality Assurance

- Engineer on site is responsible
- Pay adjustments for emulsion properties
- Distributor calibration documents to be submitted to the Engineer
- Written authorization from Engineer needed to tack coat
Low application rates
Pick up by truck and paver tires
Summary from recent projects

- Frequent picking up and tracking of tack coat by tires
- Optimum curing time usually not followed
- Not using optimum rates (often low rates)
- Quality of dilution water sometimes a concern
Why we see what we see...

- Low rates cure faster
- Comfort level with current rates
- Low rates pick up less on tires
- Not a high priority QA item
- Dilution allows very thin application
- Rates are not monitored

Comfort level with current rates:
- Low rates cure faster
- Low rates pick up less on tires
- Dilution allows very thin application
- Rates are not monitored

Not a high priority QA item:
- Comfort level with current rates
- Low rates cure faster
- Low rates pick up less on tires
- Dilution allows very thin application
- Rates are not monitored

Rates are not monitored:
- Comfort level with current rates
- Low rates cure faster
- Low rates pick up less on tires
- Dilution allows very thin application
- Not a high priority QA item

Dilution allows very thin application:
- Comfort level with current rates
- Low rates cure faster
- Low rates pick up less on tires
- Rates are not monitored
- Not a high priority QA item

Low rates pick up less on tires:
- Comfort level with current rates
- Low rates cure faster
- Dilution allows very thin application
- Rates are not monitored
- Not a high priority QA item
DECades of getting good at mixes

Opportunity

Financially it makes sense
Different/new products

- SS1-h and other standard products working well
  (Asphalt Institute, NCHRP 712)

- New, hard penetration tack now coats available
  - FastTack, Trackless Tack, Clean Bond Coat, CNT SS-1 (Cationic Non Tracking Slow Setting) etc.
  - Promising products – fast curing and less tracking
  - Long term bonding implications of hard penetration asphalt?
Next Steps for SMHI

- Implement minimum residual rates (after NCHRP 712)
- Measure actual sprayed-on tack coat application rates
- Allow other products besides SS-1
- Allow contractor to choose whether to dilute
- Develop comfort in industry with higher application rates
- Bond strength testing as future performance measure?
Louisiana Interlayer Shear Strength (ISS) Test (LISST)
NCHRP report 712

Figure 59. General description of the Louisiana Interlayer Shear Strength Tester.
Next Steps for SMHI

Field Trials

- Different products
  - Common grades
  - Proprietary blends
- Measure
  - Curing
  - Tracking
  - Bond strength
  - Long term performance

Photo courtesy of Vince Aurilio, Ontario Asphalt Pavement Council
Partnering for success

• Met with interested parties in January
  – ACP Applied Products
  – Colasphalt, McAsphalt, Husky/Pounder Emulsions, City of Saskatoon, SCETI (U of S)

• Construct 6-8 test sections on one project this summer
  – Drafting proposal

• Compare SS-1 and one other product at a time on select Ministry and City of Saskatoon projects
MHI Goals

- Variety of tack products allowed
- Reduced curing times
- Reduced tracking and pickup
- Increased/proper application rates

OPTIMIZED SPENDING- LONG LASTING PAVEMENTS
References

• NCHRP 712 – Optimization of Tack Coat for HMA Placement
• Asphalt Institute Tack Coat Workshop 2015
• Asphalt Institute tack coat information page
  http://www.asphaltinstitute.org/tack-coat-information/
saskatchewan.ca