Use of Prime Coat and Tack Coat in Asphalt Paving

Jean-Martin Croteau, P.Eng.
Technical Director
ColasCanada Inc.
Outline

• Purposes of interlayer coating
• Structural impact
• Prime-coating systems
  ➢ Existing products
  ➢ VOCs
• Tack-coating systems
  ➢ Trackless systems
  ➢ Engineering factors
Purposes of Interlayer Coating

• Tacking
• Bonding
• Waterproofing
Structural Impact

- Bonding

<table>
<thead>
<tr>
<th>Surface (40 mm)</th>
<th>Binder (80 mm)</th>
<th>Base (100 mm)</th>
<th>Base (100 mm)</th>
<th>Sub-base (225 mm)</th>
<th>Sub-grade</th>
</tr>
</thead>
</table>

**Interlayer Bond Condition**

<table>
<thead>
<tr>
<th>Surface</th>
<th>Binder</th>
<th>Base</th>
<th>Base</th>
<th>% Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td></td>
<td>Full</td>
<td>Full</td>
<td>100</td>
</tr>
<tr>
<td>Partial</td>
<td></td>
<td>Full</td>
<td>Full</td>
<td>84</td>
</tr>
<tr>
<td>Poor</td>
<td></td>
<td>Full</td>
<td>Full</td>
<td>69</td>
</tr>
<tr>
<td>Partial</td>
<td></td>
<td>Full</td>
<td>Full</td>
<td>64</td>
</tr>
<tr>
<td>Poor</td>
<td></td>
<td>Full</td>
<td>Full</td>
<td>40</td>
</tr>
<tr>
<td>Poor</td>
<td></td>
<td></td>
<td></td>
<td>13</td>
</tr>
</tbody>
</table>
Flexible Pavements. The treatment for the expected level of drainage for a flexible pavement is through the use of modified layer coefficients (e.g., a higher effective layer coefficient would be used for improved drainage conditions). The factor for modifying the layer coefficient is referred to as an $m_i$ value and has been integrated into the structural number (SN) equation along with layer coefficient ($a_i$) and thickness ($D_i$); thus:

$$SN = a_1D_1 + a_2D_2m_2 + a_3D_3m_3$$

(The possible effect of drainage on the asphalt concrete surface course is not considered.) The conversion of the structural number into actual pavement layer thicknesses is discussed in more detail in Part II, Chapter 3.

Table 2.4 presents the recommended $m_i$ values as a function of the quality of drainage and the percent of time during the year the pavement structure would normally be exposed to moisture levels approaching...
Structural Impact

- Waterproofing

Table 2.4. Recommended $m_i$ Values for Modifying Structural Layer Coefficients of Untreated Base and Subbase Materials in Flexible Pavements

<table>
<thead>
<tr>
<th>Quality of Drainage</th>
<th>Less Than 1%</th>
<th>1–5%</th>
<th>5–25%</th>
<th>Greater Than 25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>1.40–1.35</td>
<td>1.35–1.30</td>
<td>1.30–1.20</td>
<td>1.20</td>
</tr>
<tr>
<td>Good</td>
<td>1.35–1.25</td>
<td>1.25–1.15</td>
<td>1.15–1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Fair</td>
<td>1.25–1.15</td>
<td>1.15–1.05</td>
<td>1.00–0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>Poor</td>
<td>1.15–1.05</td>
<td>1.05–0.80</td>
<td>0.80–0.60</td>
<td>0.60</td>
</tr>
<tr>
<td>Very poor</td>
<td>1.05–0.95</td>
<td>0.95–0.75</td>
<td>0.75–0.40</td>
<td>0.40</td>
</tr>
</tbody>
</table>
Prime-Coating Systems

- **Purpose**
  - Tacking
  - Bonding
  - Waterproofing
- ...also
  - *Fill surface voids and binding surface fines*

To protect surface of granular base layer
Prime-Coating Systems
Prime-Coating Systems
Prime-Coating Systems

- Effectiveness
  - Viscosity
    - Cutbacks
    - Emulsions
  - Reactivity
  - Particle Size

![Particle Size Distribution](image)
Existing Products

- Cutbacks
  - No water
  - Inverted emulsions

- Emulsions
  - No solvent
  - Petroleum based solvent
  - Bio-solvent
Existing Products

- **Cutbacks** (no water)
  - *Medium or rapid curing*
    - → *MC-30, RC-30*
  - *Advantages*
    - → *Very good penetration*
    - → *Work great in cold weather conditions*
  - *Disadvantages*
    - → *High VOCs*
    - → *Low flash point*
    - → *Requires some cure time*
Existing Products

- Cutbacks (no water)
Existing Products

- **Cutbacks** (with water)
  - *Inverted emulsions*
    - \(\rightarrow\) SEP-1, SEP-2
  - **Advantages**
    - \(\rightarrow\) Very good penetration
  - **Disadvantages**
    - \(\rightarrow\) High VOCs
    - \(\rightarrow\) Low flash point
    - \(\rightarrow\) Requires some cure time
Existing Products

- **Emulsions** (no solvent)
  - *Slow setting emulsions*
    - $SS-1, SS-1h, CSS-1, CSS-1h$
  - *Advantages*
    - *No VOCs*
    - *Lower cost*
  - *Disadvantages*
    - *Variable results*
Existing Products

• **Emulsions** (petroleum based solvent)
  - *Proprietary products*
    → *EAP-2, Colasphalt Prime, EP2000...*
  - *Advantages*
    → *Less solvent than cutbacks or inverted*
    → *Good penetration*
  - *Disadvantages*
    → *VOCs*
Existing Products

- **Emulsions** (bio-solvent)
  - **Proprietary products**
    - New systems
  - **Advantages**
    - No VOC
    - No loss of solvent
    - Lower $/m^2$
  - **Disadvantages**
    - Limited field experience
## Existing Products

<table>
<thead>
<tr>
<th>Type of Prime</th>
<th>Penetration</th>
<th>Low VOC</th>
<th>Safety</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutback Asphalts</td>
<td>****</td>
<td>*</td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>Emulsified Cutbacks</td>
<td>****</td>
<td>*</td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>Emulsion – Solvent</td>
<td>***</td>
<td>**</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Emulsion – No Solvent</td>
<td>*</td>
<td>****</td>
<td>****</td>
<td>****</td>
</tr>
<tr>
<td>Emulsion – Bio-Solvent</td>
<td>****</td>
<td>****</td>
<td>****</td>
<td>****</td>
</tr>
</tbody>
</table>
VOCs

Reduction of Volatile Organic Compounds
Emissions from the use of asphalt and emulsified asphalt.

Denis Pineau
Regional Manager
Western Canada
February 5, 2013

Actions in other jurisdictions – California

- The most stringent regulations in the U.S. are those which have been promulgated by the California districts, under the California Air Resources Board (CARB). In these districts, rules are specified for rapid cure, medium cure and slow cure of cutback asphalt and emulsified asphalt.

- The following is an example from San Luis Obispo County:
  - A person shall not sell, offer for sale, use, or apply for paving, construction, or maintenance of parking lots, driveways, streets, or highways, any cutback asphalt material which contains more than 0.5 percent by volume VOCs which evaporate at 260 degrees Celsius or less.

  - A person shall not sell, offer for sale, use, or apply for paving, construction, or maintenance of parking lots, driveways, streets, or highways, any emulsified asphalt material which contains more than 3.0 percent by volume VOCs which evaporate at 260 degrees Celsius or less.
Tack-Coating Systems

- Tack-coat
  - As per BS 434 (European)
    - 0.2 to 0.4 kg/m² residual binder
    - Cationic, rapid breaking, 40% unmodified binder
    - Fluid emulsion for fine spray
    - Provides tacky surface to initiate gripping of upper layer
  - As per AI, MS-19 (North America)
    - 0.1 to 0.3 kg/m² residual binder
    - Cationic or anionic, slow breaking, unmodified binder
    - Diluted 50/50 for fine spray
    - Provides tacky surface to initiate gripping of upper layer
Tack-Coating Systems

- Bond coat (proprietary)
  - 0.3 to 0.65 kg/m² residual binder
  - Provides tacky surface for gripping of upper layer
  - Highly cohesive binders
  - Applied high rates for adhesion & waterproofing
  - Characterized using Vialit Pendulum Peak Binder Cohesion
Trackless Systems

- **Novachip approach**
  - Thin surfacing system developed by SCREG in France
  - Only 15-20 mm thick & system relies heavily on thick bond coat
    → 0.45 to 0.6 kg/m² residual binder (modified)
  - Paver integrated bond coat spraying device
Trackless Systems

- Conventional spraying approach
  - Alternative to high cost & operational difficulties of paver integrated sprayer
  - Many proprietary products
    - Colbond in the UK
    - Neoclean and Colnet in France
    - Trackless Tack in the US
Engineering Factors

- Fast breaking
  - Formulation of emulsion (spraying vs. mixing emul.)

- Shelf life
  - Formulation of emulsion (spraying vs. mixing emul.)

- Tracklessness
  - Selection of residual binder hardness
  - Spraying system (Novachip)

- Substrate bonding issues
  - Formulation of emulsion (spraying vs. mixing emul.)
  - Condition of substrate (milled surface, hot temp., old vs. new)

- Overlay thickness
  - Residual binder characteristics (cohesion and adhesion properties) and amount

- Cost
  - Residual amount, type of binder, spraying system
## Engineering Factors

<table>
<thead>
<tr>
<th>Type of Prime</th>
<th>Residual (kg/m²)</th>
<th>Fast Breaking</th>
<th>Shelf life</th>
<th>Trackless</th>
<th>Substrate Bonding Issues</th>
<th>Overlay Thickness</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tack-Coat (European)</td>
<td>0.2 to 0.4</td>
<td>yes</td>
<td>limited</td>
<td>no</td>
<td>some</td>
<td>≥ 40 mm</td>
<td>**</td>
</tr>
<tr>
<td>Tack-Coat (North-America)</td>
<td>0.1 to 0.3</td>
<td>no</td>
<td>excellent</td>
<td>no</td>
<td>no</td>
<td>≥ 40 mm</td>
<td>*</td>
</tr>
<tr>
<td>Bond Coat</td>
<td>0.3 to 0.65</td>
<td>yes</td>
<td>limited</td>
<td>yes</td>
<td>no</td>
<td>≤ 40 mm</td>
<td>***</td>
</tr>
<tr>
<td>Trackless Systems (Novachip)</td>
<td>0.45 to 0.6</td>
<td>yes</td>
<td>limited</td>
<td>yes</td>
<td>-</td>
<td>≤ 25 mm</td>
<td>****</td>
</tr>
<tr>
<td>Trackless Systems (Conventional)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>yes</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Specialized Spraying Equipment
Contact Information

Jean-Martin Croteau, P.Eng.
Technical Director
ColasCanada Inc.
1560 – 5555 Calgary Trail NW
Edmonton, Alberta
T6H 5P9
CANADA

Tel.: 780 989-1112
Fax: 780 989-1116
jmrcroteau@colascanada.ca
www.colascanada.ca