Anova Asphalt Solutions

- Rejuvenators
- Warm Mix Asphalt
- Cold Mix Solutions
  - *with or without RAP*
  - *produced with 100% RAP*
- Emulsifiers
- Anti-strip
- Modifiers

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What is rejuvenation?

• “Rejuvenation” is an inaccurate, but popular term.
  • Rejuvenators do not undo oxidative aging!!!
• A good rejuvenator reverses the impact of aging on asphalt, reactivating the bitumen, to restore performance, and durability.

- Reduce modulus/viscosity
- Restore balance of asphalt fractions
- Restore phase/colloidal stability
- Reduce brittleness / improve damage resistance
- Restore “healing” ability
- Equal (or better) aging behavior than original binder!
Re-Balancing Asphalt Fractions

- Decreasing asphaltenes content and association through balanced addition of bio-based “aromatic” and “resin” functionality.

Thin Layer Chromatography (TLC) using an iatroscan
Material Considered in this Presentation

The Rejuvenator: An Engineered Solution

<table>
<thead>
<tr>
<th>Description</th>
<th>Flash Point</th>
<th>Viscosity at 60°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineered Bio-based Rejuvenator (Anova™)</td>
<td>&gt;290°C</td>
<td>28.5 mPa.s</td>
</tr>
<tr>
<td>TFO Mass loss</td>
<td>&lt;1%</td>
<td>1.1</td>
</tr>
<tr>
<td>TFO Visc Ratio</td>
<td></td>
<td></td>
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</tbody>
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The Asphalt Binders Considered:
- RAP contents ranging from 30 to 85% by weight of mixture.
- Base binders ranging from XX-34 to PG64-22, as well as pen grades 40/50, 50/70, and 70/100.
- All are dense graded surface and base course mixes.
- All DCT tests done at climatic PG+10 temperature.
- All IFIT and Overlay tests done at 25C.
The Potential of High RAP Rejuvenation...
Performance-based Design

A common sense concept:

- Cracking Resistance
- Rutting Resistance

Design Property

Acceptable Range

Can be:
- Asphalt content
- RAP Content
- Rejuvenator dosage
- Bitumen Rheology
Adjusting Performance using Rejuvenator Dosage

- Normal paving grade asphalt + Anova can perform better than soft asphalt / flux.
Example 1:

- Rejuvenation resulted in a high improvement in durability, with minimal impact on rutting.
Example #2: 100% RAP HMA

- HMA solely consisted of RAP and Rejuvenator
- Rejuvenator sufficiently activated RAP to achieve +500 J/m² fracture energy.
- No rutting issues observed.
Improved Compaction with Proper Rejuvenation

- Use of the **rejuvenator** significantly improved the compactability, even after a 20% increase in RAP content.
  - A **25°C** improvement in compaction temperatures achieved
  - No over-compaction at hot mix temperatures.

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**Diagram:**

- Graph showing Air Voids (%) vs. Compaction Temperature (°F) for 50% RAP + Anova™ and 30% RAP.
  - 50% RAP + Anova™ line starts at 9% voids at 125°F, decreases to 3% voids at 325°F.
  - 30% RAP line starts at 10% voids at 125°F, decreases to 3% voids at 325°F.

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**Legend:**

- **50% RAP + Anova™**
- **30% RAP**

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**Label:**

- **Air Voids (%)**
- **Compaction Temperature (°F)**
  - [Plant Produced 9.5mm Surface Course]
Plant Incorporation Process

Many options for dosing:

- In virgin asphalt using additive / antistrip pump
- Pre-blended into virgin asphalt
- Pre-treatment of RAP
- Injection into pugmill
Closing Thoughts

• Proper rejuvenation can improve workability and durability of high-recycled HMA.

• The rejuvenator dosage and AC type can be used as the design property in Performance-based design methodology.

• Proper rejuvenation can “tune” the cracking performance to target values with proper balance of dosage, AC type, and AC content.

• Rutting is usually not a controlling factor in properly rejuvenated hi-recycled mixes. “Durability/Cracking Resistance” is the controlling property.

• Aging must be a consideration in performance-based designs, especially with use of additives and rejuvenators.