KEY BENEFITS OF WARM MIX ASPHALT

- Mixing temperature lower by 15 - 30 °C depending on hauls, ambient temperature and wind velocity

- Compaction temperature lower by 15 - 55 °C of HMA

- Extended Paving

<table>
<thead>
<tr>
<th>Asphalt Grade</th>
<th>Mixing Temperature °C</th>
<th>Compaction Temperature °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>VG 10</td>
<td>120 – 130</td>
<td>90 – 115</td>
</tr>
<tr>
<td>VG 30</td>
<td>125 – 135</td>
<td>95 – 120</td>
</tr>
<tr>
<td>CRMB</td>
<td>145 – 155</td>
<td>115 – 140</td>
</tr>
<tr>
<td>PMB</td>
<td>145 – 155</td>
<td>115 – 140</td>
</tr>
</tbody>
</table>
**WARM MIX ASPHALT – KEY BENEFITS**

<table>
<thead>
<tr>
<th>Environment Friendly</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reduced emissions in stack, 90% Relief on fumes at the loading dock &amp; paver</td>
</tr>
<tr>
<td>• VOC reduced by 60-70% at the paver</td>
</tr>
<tr>
<td>• Paving asphalt binder rated as 2B (possibly carcinogenic to humans) by IARC, Oct. 2011</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Energy Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Lower Fuel Cost by 11 – 14% (Ref latest practical studies, NAPA Annual meeting, Feb. 2012)</td>
</tr>
</tbody>
</table>
EXISTING WMA TECHNOLOGIES

Chemical additives allow easier processing & coating of aggregates

Surfactants
- Reduce surface tension of asphalt binder

Wax Additives
- Reduce viscosity of asphalt binder
EXISTING WMA TECHNOLOGIES

Water injection allows for easier coating of aggregates

- **Direct Water Injection**
  - Expand surface area of asphalt binder via water to steam expansion.

- **Zeolites**
  - Release of water from natural mineral during mixing, thereby expanding surface area via water to steam expansion.
## EXISTING WMA TECHNOLOGIES

### DRAWBACKS

<table>
<thead>
<tr>
<th>Additive</th>
<th>TSR</th>
<th>Rutting</th>
<th>Compactibility</th>
<th>Dosing / Mixing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surfactant</td>
<td>OK</td>
<td>High possibility</td>
<td>Good</td>
<td>Easy</td>
</tr>
<tr>
<td>Wax</td>
<td>Poor</td>
<td>Not Affected</td>
<td>OK</td>
<td>Needs additional melting</td>
</tr>
<tr>
<td>Water</td>
<td>Poor</td>
<td>Not Affected</td>
<td>Poor</td>
<td>Water injection (poor control)</td>
</tr>
<tr>
<td>Zeolite</td>
<td>Poor</td>
<td>Not Affected</td>
<td>Poor / OK</td>
<td>Solid powder dosing (poor control)</td>
</tr>
</tbody>
</table>
THE BEST WMA TECHNOLOGY SOLUTION

✓ Odor free additive, increases moisture resistance

✓ Lowers mixing and compaction temperatures up to 36 °C

✓ Substantially enhances Salt Resistance of pavements over Hot mix technologies

✓ Resolves stripping & quick degradation of Mountain / Coastal pavements (No effective solution with Hot mix technologies)
THE BEST WMA SOLUTION

ZycoTherm

- Terminally Blendable, stable for 15-30 days
- Fuel Savings 11-14%
- Compatible with all grades of asphalt binder
- No Odor
- Moisture Resistance
- Salt Resistance
### TESTING & RESULTS

<table>
<thead>
<tr>
<th>Improved TSR (Same / Higher compared to HMA)</th>
<th>Consistent Compaction across temperatures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equivalent Rut Performance</td>
<td>Improved Salt Resistance</td>
</tr>
</tbody>
</table>

Superpavemix 9.5 mm NMAS designed using PG 67-22 binder and moisture susceptible crushed Granites, tested as per AASHTO T323-07 & AASHTO R35-09
LOW MIXING & COMPACTION TEMPERATURES

Mixing and Compaction temperatures lower upto 36 °C

Mixing

Compaction

HMA

Zycotherm
**HIGHER TENSILE STRENGTH RATIOS, AASHTO T283**

![Graph showing comparison of wet and dry strengths between HMA and ZycoTherm under specified conditions.](image)

- **Wet and Dry strengths**
  - *Control HMA at 135 °C*
  - *ZycoTherm at 120 °C*

*Conditioning for 2hrs*
IMPROVED RUT RESISTANCE, AASHTO T340-10

Rut < 5 mm acceptable

Average Rut Depth (mm)

Manually

Automatically

* HMA at 135 °C
* Zycotherm at 120 °C

*Conditioning for 2hrs
HIGHLY RESISTANT TO SALT ACTION, ASTM D3625 4% SALT WATER BOIL TEST

- Control:
  - *135 °C

- 1% Hydrated lime:
  - *135 °C

- 0.5% Amine:
  - *135 °C

- ZycoTherm:
  - *120 °C
  - *Conditioning for 2 hrs

✓ Retains 95% coating as against 15 – 25 % in lime / amines
✓ Excellent anti-strip performance
SYNOPSIS
ZYCOTHERM BENEFITS

Lower Temperatures
Mixing & Compaction temperatures lower by 36 °C

Improves Moisture Resistance
TSR increased from 0.46 to 0.82

Maintains Rut Resistance (No Significant Drop)
Satisfactory Rut Resistance (< 5mm)

Increases Salt Resistance
Excellent anti-strip, retains 95% coating
DOSAGE AND APPLICATION

✓ Effective at 0.1% for most of the asphalt binders and at 0.125% for Polymer & CRMB binders

✓ Very Low odor additive, easily blends at the terminal

✓ Reduces asphalt binder odor by 70-80% and nearly eliminates white smoke

✓ Stable for 15 – 30 days

✓ Non flammable
Thank you