CECABASE RT: Additives for warm mix asphalts
CECABASE RT Additives

Liquid water free chemicals introduced in asphalt binder (6 to 10 lbs./ton)

- First lab results obtained in 2002
- First industrial project realized in 2004
- Numerous awards from chemical and road industry worldwide:
  - Global Road Achievement Awards 2009
  - “Technology, Equipment and Manufacturing”

Commerically available in USA since summer 2009
Main physical properties for Cecabase RT 945

- **liquid:**
  - Density: 0.997 or 8.30 lbs./gal
  - Flash point: > 390 F
  - Readily soluble in asphalt binder

### Good practices:

- **In line or batch** addition to the asphalt binder
- 0.3 to 0.5% dosage based on total binder weight
- **Compatible** with all kinds of binders and formulations
- **Stable** in stored asphalt binder over 7 days (based on laboratory studies)
- Mix production temperature between 240 and 280 F depending on mix type
- Good compaction ability down to 190 F
Binder testing laboratory results
Effect of Cecabase RT on binder properties

No modification of the asphalt binder grade

- **Penetration and R&B temperature unchanged**

<table>
<thead>
<tr>
<th></th>
<th>Penetration (1/10 mm)</th>
<th>Softening point (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neat AC Pen 50/70 ~ PG 70-22</td>
<td>51</td>
<td>124</td>
</tr>
<tr>
<td>AC + 0.5% Cecabase RT</td>
<td>51</td>
<td>123</td>
</tr>
<tr>
<td>Neat AC Pen 30/45 ~ PG 70-22</td>
<td>33</td>
<td>130</td>
</tr>
<tr>
<td>AC + 0.5% Cecabase RT</td>
<td>37</td>
<td>129</td>
</tr>
<tr>
<td>SBS modified AC ~ PG 76-28</td>
<td>52</td>
<td>136</td>
</tr>
<tr>
<td>AC + 0.5% Cecabase RT</td>
<td>56</td>
<td>135</td>
</tr>
</tbody>
</table>

- **Viscosity unchanged** by the additive at concentrations used

Dynamic viscosity measured at constant shear rate: 100 s⁻¹
Mix testing laboratory results
Electron microscopy observation of a Warm Mix Asphalt made with Cecabase RT

- Good *repartition* of aggregates
- Excellent *coverage* of aggregates (even fines)

> No noticeable *difference* with a HMA
Mix workability

Evaluated by a German laboratory (Baustofflabor Hamburg) following standard German test for workability (torque recording of a screw type rotational device introduced in the mix)

- 8 mm nominal maximum aggregate size dense graded mix (asphaltbeton 0/8)
- Neat asphalt binder 50/70 pen (~ PG 70-22)
- With (30%) and without RAP

**Mix workability as a function of temperature**

- HMA produced at 320 F
- WMA contains 0.5% Cecabase RT and is produced at 240 F

Test described in:
Merkblatt fur temperatur absenkung von asphalt
Published by FGSV, aug. 06
Compaction and ITSR

- Compaction with a gyratory compactor at a constant condition: 600 kPa, 40 gyrations
- Conditioned sample is soaked 1 day in water at 140 F

<table>
<thead>
<tr>
<th></th>
<th>T °C bitumen</th>
<th>T °C aggregates</th>
<th>T °C compaction</th>
<th>r/R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference HMA</td>
<td>160</td>
<td>160</td>
<td>160</td>
<td>0.58</td>
</tr>
<tr>
<td>Reference WMA (no additive)</td>
<td>160</td>
<td>120</td>
<td>120</td>
<td>0.31</td>
</tr>
<tr>
<td>WMA with 0.4% CBRT945</td>
<td>160</td>
<td>120</td>
<td>120</td>
<td>0.84</td>
</tr>
</tbody>
</table>
Compaction and ITSR

- Compaction with a gyratory compactor at a constant condition: 600 kPa, 40 gyrations
- Conditioned sample is soaked 1 day in water at 140 F

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<tbody>
<tr>
<td>Reference HMA</td>
<td>160</td>
<td>160</td>
<td>160</td>
<td>0.35</td>
</tr>
<tr>
<td>Reference WMA (no additive)</td>
<td>160</td>
<td>120</td>
<td>120</td>
<td>0.11</td>
</tr>
<tr>
<td>WMA with 0.4% CBRT945</td>
<td>160</td>
<td>120</td>
<td>120</td>
<td>0.64</td>
</tr>
</tbody>
</table>
Hamburg Test

Evaluated by a German laboratory (Baustofflabor Hamburg) following German standard (Steel wheel in a water bath at 122 F)

- 8 mm nominal maximum aggregate size dense graded mix (asphaltbeton 0/8)
- Polymer modified asphalt binder (~ PG 76-28)

Samples produced from industrial mix (manufactured at 350 F) that has been reheated before Marshall hammer compaction:
280 F for WMA and 320 F for HMA
# Rutting resistance

Evaluated by Malet laboratory (France) following French standard (real rubber tire on a large compacted plate sample)

- 10 mm (~ 3/8 in) nominal maximum aggregate size dense coarse graded mix
- Asphalt binder ~ PG 76-22

### NF P 98-253-1

<table>
<thead>
<tr>
<th></th>
<th>Hot mix asphalt</th>
<th>Warm mix asphalt</th>
<th>Limits in the std.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rutting (%) after 30,000 cycles</td>
<td>4.11</td>
<td>4.19</td>
<td>&lt;5</td>
</tr>
<tr>
<td>Air void (%)</td>
<td>6.7</td>
<td>6.7</td>
<td>5&lt;P&lt;8</td>
</tr>
</tbody>
</table>

### Asphalt binder Temperature (°F)

<table>
<thead>
<tr>
<th></th>
<th>Hot mix asphalt</th>
<th>Warm mix asphalt (0.4% Cecabase RT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt binder Temperature (°F)</td>
<td>320</td>
<td>320</td>
</tr>
<tr>
<td>Mineral aggregates Temp. (°F)</td>
<td>320</td>
<td>240</td>
</tr>
<tr>
<td>Compaction Temp. (°F)</td>
<td>320</td>
<td>230</td>
</tr>
</tbody>
</table>
Field Tests in Europe
First **field test** for technology validation:

- 300 tons of mix
- All production conditions under control
- 10 mm (~ 3/8 in) nominal maximum aggregate size
  dense coarse graded mix
- Asphalt binder ~ PG 76-22

<table>
<thead>
<tr>
<th></th>
<th>Hot mix asphalt</th>
<th>“Warm” Hot mix asphalt (no additive)</th>
<th>Warm mix asphalt (0.5% Cecabase RT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production T (°F)</td>
<td>320</td>
<td>240*</td>
<td>240*</td>
</tr>
<tr>
<td>Laying T (°F)</td>
<td>320</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>Start of Compaction T (°F)</td>
<td>270</td>
<td>190</td>
<td>190</td>
</tr>
</tbody>
</table>

*mineral aggregate temperature
Atlanroute 2004

- **Continuous dryer/Mixer**
- **Batch addition** of binder to the aggregates in the pugmill
- **Standard** Fabrication Equipment.
Low temperature compaction

The **same equipment** and **identical compaction** conditions were used in all lanes.
Measured mix Air void after compaction

- **Constant compaction** conditions
- Troxler: gamma rays absorption
- At least 20 measurements per lane
- Core sampling to verify

![Graph showing air void for different asphalt types](image)

- **Hot Mix Asphalt**
  - Prod. 320°F
  - Comp. 270°F

- **“Warm” Hot Mix Asphalt**
  - Prod. 250°F
  - Comp. 190°F

- **Warm Mix Asphalt (0.5% Cecabase RT)**
  - Prod. 250°F
  - Comp. 190°F

Air void target
Cored samples cohesion measurement

- From cored samples
- All cores rectified to a constant thickness

**Indirect tensile strength (kN)**

<table>
<thead>
<tr>
<th>Material</th>
<th>Production Temperature</th>
<th>Compaction Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMA</td>
<td>320°F</td>
<td>270°F</td>
</tr>
<tr>
<td>“Warm” HMA</td>
<td>250°F</td>
<td>190°F</td>
</tr>
<tr>
<td>WMA Cecabase RT 0,5%</td>
<td>250°F</td>
<td>190°F</td>
</tr>
</tbody>
</table>
Stone Matrix Asphalt – Poland (2007)

Difficult conditions for workability and compaction:

- 8 mm nominal maximum aggregate size SMA (0.4% fibers in the mix)
- Polymer modified Asphalt binder ~ PG 76 -28
- 3000 tons of mix

\[
\begin{align*}
T_{\text{fabrication}} &= 270^\circ F \\
T_{\text{application}} &= 250^\circ F \\
T_{\text{compaction}} &= 210^\circ F
\end{align*}
\]

Density after compaction OK
A64 highway – Pau (France) - 2009

Thin hot mix asphalt overlay, open graded
500 tons produced at 250°F

High volume road : AADT > 15000

### Gradation used

<table>
<thead>
<tr>
<th>Sieve</th>
<th>passing %</th>
</tr>
</thead>
<tbody>
<tr>
<td>N°8</td>
<td>25</td>
</tr>
<tr>
<td>N°4</td>
<td>25</td>
</tr>
<tr>
<td>3/8 in</td>
<td>90</td>
</tr>
<tr>
<td>1/2 in</td>
<td>100</td>
</tr>
</tbody>
</table>

- + 1% limestone filler

- 5.7% Polymer modified binder (neat PG 76-22 + 4% SBS)
- Cecabase RT945 used at 0.4%, added in tank 5 days before
North American Projects already realized
North American projects already realized

1. 1300 t in NY state with Barrett paving (aug 2008)
   - River road (1 mile North from Rd 31 along Seneca river), WMA Southbound and HMA control Northbound
   - Dense graded mix with 30% RAP
   - Production between 250 and 270 F
   - Workability good down to 250 F

2. Another 1000 t in NY state with Barrett paving (aug 2008)
   - Road 18 near Utica, WMA and HMA control
   - Dense graded mix without RAP, production between 250 and 270 F, good workability at 250 F
North American projects already realized

- 25 000 tons in Alberta with Works Alberta (Sept 09)
  - Interstate 35 approximately 5 miles north from Meander river

- Dense graded mix without RAP (gravel pit aggregates)
- Asphalt binder 200-300 Pen. with antistrip (+ 4 lbs. / ton Cecabase RT945)
- Production Temp.:
  - HMA control (300 F) on previous job
  - WMA (250 F)
North American projects already realized

- 400 tons in Georgia with Reeves (Nov. 09)
  - Close to Macon (GA)

Comparative project with Evotherm 3G and Rediset WMX
Followed by NCAT and Georgia DOT
More than 500,000 tons layed with Cecabase RT technology in the last 3 years and no failure
- All kinds of traffic
- Many different mix type (Dense graded, SMA, OGFC …)
- Many kinds of binder (hard, soft, polymer modified …)
- All kind of weather (from Australia in summer to Russia in late fall)

An average 70 F production temperature lowering observed

No major differences with Hot mix

Available in USA since summer 2009