PRESENTATION SUMMARY

• Method of foaming asphalt

• Use of foamed asphalt in a Double Barrel to produce warm mix

• Test projects completed to date

• Benefits of Astec warm mix
HOW THE DOUBLE BARREL GREEN WMA PROCESS WORKS
CROSS-SECTIONAL VIEW OF MIXING IN OUTER DRUM

Recycle Entry

AC Entry

Discharge

Virgin Aggregate
RAP IN generates steam in the outer drum.
How the Foam System Works!
How much water?

1 lb. of water per ton of mix

One ton of mix has 5.3% A/C liquid or 106 lbs.

Volume of liquid – 1.63 cu. ft.

1 lb. H₂O when converted to steam = 30 cu. ft.

Expansion - \[
\frac{30}{1.63} = 18
\]
NORMAL COATING

DB GREEN FOAM COATING

COATING THICKNESS

9 mm

165 mm
VISCOITY / TEMPERATURE   PG 64 -22 (Approx.)
COMPLETED Projects...
1. ASTEC, INC.

Main production facility

- **Project location:** Jerome Avenue, Chattanooga, TN
- **Contact:** Scott Thompson with Southeastern Materials Company, Rossville, GA
- **Date of project:** April 18, 2007

- 300 tons of virgin surface mix at 240° F;
- 300 tons of binder mix with 30% RAP at 270° F;
- 300 tons of surface mix with 30% RAP at 270° F
• 300 tons of virgin surface mix at 240° F
Shoveling & Raking said to be comparable to Hot Mix
• 300 tons of binder mix with 30% RAP at 270° F
• 300 tons of surface mix with 30% RAP at 270° F
2. CITY OF CHATTANOOGA in Chattanooga, TN

- Project location: North Terrace Road, Chattanooga, TN

- Date of project: June 21, 2007
- 4,200 tons with 50% RAP at 270° F

- Contact: Scott Thompson with Southeastern Materials Company, Rossville, GA
City of Chattanooga Project

June 21, 2007

- City agreed to mill high traffic road and use 50% RAP @ 270°F with 64-22

“The Environmental City”

- The RAP was fractionated
- The AC was foamed
- Southeastern Construction milled 2 inches and placed 2 inches
- 4200 tons
PROJECT OBSERVERS

• CITY OF CHATTANOOGA
• NCAT
• NAPA
• NIOSH
• STATE OF TN
• STATE OF NC
• STATE OF SC
Evaluation of Mix

- NCAT was present to evaluate the mix
- NCAT represented by Dr. Ray Brown & Dr. Andrea Kvasnak
- Material was compacted on site
- Material was transported to NCAT Auburn Univ lab for testing
Prototype water injector located on the liquid asphalt intake on drum.
Testing the temperature of the “Green” mix.
All mix processed through Roadtec Shuttle Buggy
NCAT Conclusions

• It is too early to make final conclusions but the mix at the lower temperature does have good workability, is easy to place and compact, and has no smoke. The testing generally provided good results with a couple of exceptions. The moisture susceptibility was marginal but this can be improved if needed by adding an anti-strip agent. This does not appear to be an area of major concern.

• The density was lower than desired. The in-placed density should show at least 92 to 94% of TMD. So the density is a couple of percentage points low. With improved rolling techniques this can be brought into specification requirements.
• The laboratory air voids were a little high but this could be improved by increasing the asphalt content

• In summary, the mix continues to look promising and additional small projects should be constructed so that the evaluation of this mix type can continue.
3. S. T. WOOTEN CONSTRUCTION COMPANY in Wilson, NC

- **Project location:** Johnson County, North Carolina
- **Contact:** George Reeves at S.T. Wooten Construction Company, Wilson, NC
- **Date of project:** September 12, 2007
- **Approximately 2,000 tons of binder mix with 40% RAP at 260º F, 2,000 tons of surface mix with 40% RAP at 260º F
Binder mix at 240º F in Paver Hopper
4. LAFARGE COLUMBIA BITULITHIC DIVISION

in Vancouver, British Columbia

Project location: Vancouver, British Columbia

- Contact: Bob Forfylow at Lafarge Canada, Calgary, Alberta
- Date of project: September 22, 2007
- 200 tons of mix with 50% RAP at 250º F
Plant has 4 RAP Bins
(one for processed shingles)
Loading Warm Mix
Loading Hot Mix
5. LOJAC ENTERPRISES, INC. Lebanon, TN

Project location: Williamson County TN
S.R. 46 from US431 to S.R. 96

• Contact: Don Chambers

• Date of project: Week of Oct. 1, 2007

• 6 miles of S.R. 46 Approx 1500 tons of each of the following WMA processes:

**ADVERA® WMA** by PQ Corporation

**Double Barrel® Green System** by Astec Industries

**EVOTHERM** by MeadWestvaco

**Sasobit®** by Hi-Tech Asphalt Solutions, Inc.
No smoke at Paver Hopper
<table>
<thead>
<tr>
<th>Mix Comparison From Franklin Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advera WMA</strong></td>
</tr>
<tr>
<td>1150 Tons Placed</td>
</tr>
<tr>
<td>% AC 5.16 &amp; 5.28</td>
</tr>
<tr>
<td>% Air Voids 4.7</td>
</tr>
<tr>
<td>Stability 1475</td>
</tr>
<tr>
<td>TSR 51.9%</td>
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<tr>
<td>Density 92.7%</td>
</tr>
<tr>
<td><strong>Sasobit</strong></td>
</tr>
<tr>
<td>705 Tons Placed</td>
</tr>
<tr>
<td>% AC 5.14</td>
</tr>
<tr>
<td>% Air Voids 3.5</td>
</tr>
<tr>
<td>Stability 1825</td>
</tr>
<tr>
<td>TSR 65.5%</td>
</tr>
<tr>
<td>Density 91.0%</td>
</tr>
</tbody>
</table>
Mix Comparison From Danley and Murfreesboro Plant

- Astec Green System
  - 775 Tons Placed
  - % AC 5.19 & 5.29
  - % Air Voids 4.0
  - Stability 2200
  - TSR 84.3%
  - Density 91.6%

- Evotherm
  - 750 Tons Placed
  - % AC 5.22 & 5.36
  - % Air Voids 5.1
  - Stability 1455
  - TSR 72.7%
  - Density 91.0%
6. BOGGS PAVING

- **Project location:** York County, S.C.
- **Contact:** Drew Boggs
- **Date of project:** October 11, 2007
- **High Traffic Subdivision Road 50% RAP Fractionated 270° F mix with PG64-22**
PLANT RAP FRACTIONATION
This Street Paved With Environmentally Friendly Warm Mix Asphalt

York County South Carolina

Boggs PAVING, INC. GREEN

ASTEC
PROJECTS planned in 2008...

- Alabama - 1
- California - 2
- Florida - 3
- Georgia - 1
- New Hampshire - 1
- North Carolina - 2
- Ohio - 2
- South Carolina - 1
- Utah - 1
- Virginia - 1
- Canada - 2
- Sweden - 1
RESULTS and BENEFITS
• Good Workability
• Good Workability
• No Smoke - No Smell
No Smoke – No Smell…Why?

- Light oils are either put in asphalt or left in asphalt during refining
- These light oils boil at above 285°F
- By mixing at below 285°F, the boiling point is never reached...eliminating smoke (vapor) and corresponding smell
• Good Workability
• No Smoke - No Smell
• High Percentage Recycle Mix with Standard Grade of Asphalt
- Improved Workability
- No Smoke - No Smell
- High Percentage Recycle Mix with Standard Grade of Asphalt
- Longer Life Pavement
Why will we have a Longer Life Pavement?

- Less oxidation of mix
- More uniformity of compaction
- With fractionating RAP...more uniform
• Improved Workability
• No Smoke - No Smell
• High Percentage Recycle Mix with Standard Grade of Asphalt
• Longer Life Pavement
• 11% Less Fuel
• 11% Higher Production
Why Green?

- Use 11% less fuel due to 50°F lower temperature
- No volatiles
- Use more recycle
Summary of Astec Green Benefits

- Comfort & safety of workers
- Eliminates need for fume systems on plants & pavers
- Improved mixes
- Extend resources by recycling more
- Use 11% less fuel
- 11% increase in plant production
- No increase in cost of mix