

WARM MIX ASPHALT: RAP Content and Foaming Asphalt

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Today's Topics

- Warm Mix plus RAP
- Warm Mix by Foaming

Selected Concerns

Warm Mix

- Moisture in the mix
 - ▣ Increased stripping?
- Lower production temperature = less aging
 - ▣ Softer binder = increased rutting?

RAP

- Oxidized RAP Binder
 - ▣ Stiffer binder = more cracking?

Why Warm Mix Plus RAP?

- Superheating virgin aggregate increases chances of drying
 - ▣ Less moisture in the warm mix
- Less aging of virgin binder
 - ▣ Helps counteract oxidized RAP binder (without changing grades?)
- Increased stiffness from RAP binder
 - ▣ Reduces rutting susceptibility

Will it Work?

- Will RAP binder blend with virgin at lower temperatures?



Field Trials – WMA with RAP

- Tennessee – 2
- Alabama
- South Carolina
- Missouri

- Evaluated by NCAT, NCSC, DOTs, others

Tennessee

- Astec Plant Parking Lot
 - ▣ Foamed asphalt – 0.1% moisture added to mix
- 30% RAP in base and surface
- Control surface mix with no RAP
- Compaction Temperatures
 - ▣ 245 F for Virgin
 - ▣ 265 F for RAP
 - ▣ Good workability

Lab Testing Results

- Mobile lab compacted specimens at location
- Moisture Susceptibility
 - 30% RAP base and virgin surface > 0.9 TSR
 - 30% RAP surface ~ 0.58 TSR
- Asphalt Pavement Analyzer
 - RAP mixes performed better than virgin
- Hamburg Wheel Tracking Device
 - Stripping inflection points $< 10,000$
 - RAP mixes passed, virgin did not

Reported by Andrea Kvasnak, NCAT

City of Chattanooga

- 50% RAP with foamed asphalt (PG64-22)
- 4200 tons, 50 mm mill and fill
- 270°
- Moisture Susceptibility
 - ▣ Average TSR of 0.8
- Asphalt Pavement Analyzer
 - ▣ Average rut depths < 4 mm
- Hamburg Wheel Tracking Device
 - ▣ Ruts < 5 mm
 - ▣ Stripping inflection < 10,000

Reported by Andrea Kvasnak, NCAT

Alabama

- SR 79
- Night time paving
- WMA and HMA produced and placed
 - ▣ WMA: 15% RAP
 - ▣ HMA: 10% RAP and 5% shingles
 - ▣ Originally considered RAS for both
 - ▣ Evotherm
- Moisture susceptibility – 3 of 4 passed
- APA – WMA 5mm, HMA 3mm

Reported by Andrea Kvasnak, NCAT

South Carolina

- 50% FRAP WMA at 270°
- APA Rut Depths
 - ▣ 0% RAP HMA – 8.30mm
 - ▣ 30% RAP HMA – 4.40mm
 - ▣ 50% RAP HMA – 3.15mm
 - ▣ 30% RAP WMA – 2.85mm

Data from Clemson Univ. Reported by Drew Boggs

Others

- South Carolina - 50% FRAP WMA at 270°
- California – 15% RAP at 265°
- British Columbia – 50% RAP at 250°
- New Jersey – 30% RAP at 240-270°
- Wisconsin – 20-30% RAP at 220-240°
- New York – 13% RAP, 25% less fuel

Missouri – First Experience

- Paving over crack seal with HMA caused bumps
- Thought maybe WMA would not
- Substituted WMA – three technologies
- 10% RAP
- Temps as low as 230°

Missouri Experiment

- 2008 project
- HMA Control with 20% RAP
- WMA with 20% RAP
- WMA with 28% RAP
- WMA with 35% RAP
- Low temp cracking, fatigue, rutting, etc., being evaluated

RAP + WMA

- High RAP contents or stiff RAPs may require higher temps than "normal" WMA
- Long term field performance not proven in USA
 - ▣ Some European experience ≥ 8 years
- Has the potential to allow higher RAP contents without changing grade
- RAP may help reduce concerns with WMA
 - ▣ Moisture in mix, early rutting
 - ▣ Watch moisture content of the RAP and virgin agg

Warm Mix by Foaming Processes

- Additive Foaming Technologies
- Foaming with Wet Sand (may include additive)
- Injecting Water

Attractive Options

- No additive options may be less expensive.



Water + Asphalt

- Sound familiar?