Implementation of Warm Mix Asphalt

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What's in HMA?
Hot Mix Asphalt Components

Asphalt Binder

Aggregate

Air
What's in WMA?
Warm Mix Asphalt Components

Asphalt Binder

Aggregate

Air
Warm Mix Asphalt is the new Norm!
REGARDLESS OF METHOD

WMA is made by modifying binder so it temporarily lowers its overall viscosity and increases its volume
Why do we heat HMA?

- To remove moisture
- To coat aggregate
- To provide for heat transfer to RAP
- To transport mix
- To compact mix
Mix Design
Asphalt, Stability, Voids, Workability

Mix must meet all criteria
Mixture Types

• Dense Graded
• Gap Graded
  – SMA
• Open Graded
Pick the Right Applications
Lower the Temperature

The goal:
Produce, lay and compact at lower temperature

without losing quality and compaction time
Benefits of lower temperatures

- Lower fumes
- Lower plant emissions
- Lower energy consumption
- Lower plant wear
- Decreased binder aging
Goals for WMA

• Lower production temperature of Hot Mix Asphalt
• Use existing Hot Mix Asphalt plants
• Meet existing standards for HMA
• Drop into JMF
Warm Mix Asphalt

Up to 100°F less than Hot Mix

Warm Mix  Hot Mix
What constitutes WMA??

• Some trying to define a temperature reduction
• Some agencies taking lower temperature out of spec
• As long as density is achieved, who cares?
Available Technologies

Foaming

Chemical Modifiers
## Technology Providers

### Foaming
- Advera
- Aspha-min
- Accu-Shear
- Aquablack
- Aqua Foam
- DB Green
- Green Machine
- LEA
- Terex
- WAM

### Chemical Modifiers
- Cecabase
- Evotherm
- Revix
- Rediset
- Sasobit
- Thiopave
This presentation is not intended to recommend or promote any particular WMA technology.
Warm Mix Use
NAPA WMA Survey

- 92% of WMA produced by foaming
- 8% produced using additives
- Over 40 million tons WMA produced last year
Warm Mix Asphalt using Foaming
Foaming Lessons Learned

✓ More water may not improve foaming
✓ Not all asphalts foam the same
✓ Excessive water may make mix “gummy”
✓ Control water
✓ Best fit process: Mix/Water/Plant
Foaming systems add too much water to the mix.
• 300 ton of mix x 6.0% ac
• 18 liquid ton x ~1.25 (to 2.5)%
• Equals 450 (900) lbs. water
• Or…54 (108) gallons

• Allowable moisture in completed mix = < 0.5%.
• 300 ton of mix x 0.5% = 3000 Lbs. of water
• Or…360 gallons.

– Almost 7 of these.
Harman Lab Foaming Device
WMA - An illusion?

NO!
Warm Mix Construction
WMA Temperatures

- Plant: 230 to 270F
- Field: 220 to 260F
Moisture Sensitivity
If you had an issue with HMA, you’ll have an issue with WMA.
Mix Properties meet project specifications
• Handles like HMA
  – Mix a bit stiffer
• Hauling as usual
• Shuttle buggy OK
• Any paver OK
• Lower temperature
• Slight odor
Rolling Pattern

HMA
• Roller 1 - IR90HF (4)
  – vibratory
• Roller 2 - IR90 (3)
  – static

WMA
• Roller 1 IR90HF(4)
  – vibratory
• Roller 2 IR90 (4)
  – static
Density is seldom a problem.
Traffic allowed at 140F
NO SMOKE AT THE PAVER!
What has driven WMA use?
WMA Drivers

• Industry has led the way
  – Scanning Tour in 2002
  – NAPA WMA Task Force
• FHWA is supporting the effort
  – Technical Working Group
• 41 states and FHWA have a spec and/or contract language allowing WMA
WMA Drivers

• Environmental Concerns
• Energy Savings
• Health and Safety Improvement
• Constructability Advantage
• Good Performance
WMA Environmental Impact

- $\text{CO}_2$ generally reduced
- $\text{NO}_x$ reduced in all cases
- $\text{SO}_2$ and VOC variable
WMA Environmental Impact

• Saved 30 million gallons of fuel during production
• Reduced CO$_2$ emissions by 800,000 tons
  – Equivalent to taking 150,000 vehicles off road
WMA Environmental Impact

• Burner Tuning huge issue
  – Incomplete combustion increases CO and VOC
  – Emissions indicate improper tuning
Industry Perspective

• WMA is becoming the standard
• Higher percentages of RAP will be possible
• Energy Savings
• Better density in pavements
• Extend haul distances
• Extend paving season
Industry Drivers

- Reduction in worker exposure
- Sustainability (energy and GHG)
- Competitiveness
  - RAP/RAS
  - Haul distance improvement
  - Extend paving season
Worker Exposure

Hot Mix

Warm Mix
Achieving Density

- WMA improves coating
- Better lubrication
- Better compactability
- Less variability in density
- Fewer rollers??
- Wider window for rolling
Improved Density = Improved Performance

• The BAD mix with GOOD density out-performed the GOOD mix with POOR density
WMA vs. HMA

- Not a competition
- It’s all asphalt
- WMA improves quality of mixes
- WMA another tool
- Adjust as necessary
- Communicate with customers
Remaining Challenges

- Changing culture of paving crews/customers
  - Hotter is not always better
- Plant operations when both conventional and WMA are produced
- Dealing with possible low TSR results
- Compaction control
Path Forward

- Industry must remain proactive
- Agency with permissive specs
- Let market decide appropriate technologies
Path Forward

- WMA should be an acceptable alternative
- Contractor’s discretion for use
- WMA must meet all applicable specifications
Path Forward

• Quickly maturing technology
• Benefits all parties
  – “Greener” asphalt
  – Good economics
  – Improved density/performance
Path Forward

- Practical research to develop technology
- Avoid making it too complicated
The Keys to Success...

- Specifications
- Quality Aggregate
- Consistent Gradation
- Stockpiling
- Mix Design
- Plants
- Sampling / Testing
- Trucks
- Paving
- Rollers
- Compaction
- QC/QA
The Key to Success...

DO IT RIGHT !!!
Warm Mix Asphalt is the new Norm!
Thank You!

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