BEST PRACTICE FOR COMPACTING WARM AND HOT MIX ASPHALT

NEAUPG

OCTOBER 7, 2009
GOALS
DAILY
SAFETY-Quality-Production

- EVERY PROJECT
- EVERY DAY
- EVERY TON
101 COST SAVING IDEAS FROM NAPA

- WARM MIX ASPHALT
- RAP
- STOCKPILE PROPERLY
- ESTABLISH TRAINING FOR PAVING CO. CUSTOMERS
30,000 Tons of RAP = 70 - 6,000 Gallon Transport Trailers and 28,200 Tons of Clean Aggregate

RAP is Worth the Virgin Material It Replaces
What is WMA?

- Process or additive that allows for the production and compaction of asphalt pavements at temperatures lower than traditional HMA
  - Reduction can range between 275 - 185°F
  - Different mixes and technologies dictate temperature change
WMA Technologies Used in North America

- **Foaming**
  - Double Barrel Green
  - Terex Warm Mix Asphalt System
  - Gencor
  - Stansteel
  - LEA
  - Aspha-min
  - Advera WMA
  - WAM Foam

- **Organic Additive**
  - Sasobit

- **Chemical Additive**
  - Evotherm
  - Evotherm DAT
  - REVIX
  - Rediset WMX
  - Cecabasa RT
Summary of WMA Introduction to Drum Plants

- Foaming Devices
  - Foaming unit injects pressurized water into binder

OR

- Wet sand is introduced at the RAP collar
Summary of WMA in a Drum Plant, cont.

- Additives
  - Typically injected near binder line
  - Terminal blending is an option for some technologies
    - Sasobit
General Differences Between Technologies

- Foaming using just water is less expensive but the drop in temperature is also less
  - May need an anti-strip agent

- Some of the additives alter binder properties
  - i.e. Sasobit

- Some additives act like additional fines
  - i.e. Aspha-min and Advera WMA
Benefits of WMA

- Energy savings
- Reduced emissions
- Extended paving season
- Increased haul distance
- Reduced issues with crack sealant
- Less oxidized binder
  - Less brittle, may endure cold better
  - Softer binder good for high RAP content mixes
HMA vs. WMA

Hot Mix (155 °C) 311 °F

WMA (110 °C) 230 °F
HMA - 315° F

Aspha-Min WMA - 265° F
Similarities With HMA

- Same plants, just modified in many cases
- Same paving equipment
- Same rolling equipment
Concerns About WMA

- Moisture susceptibility
- Rutting
- Affect on baghouse
- Coating
- Cooling
- Activate RAP and RAS binder
- Compatibility with polymer modified binder
- Expense
How Are The Concerns Being Addressed?

- **Moisture susceptibility**
  - Anti-stripping agents
  - Monitoring of pavement performance
  - Checking moisture content of mix
  - To date no issues with moisture damage in the field

- **Rutting**
  - Binder is less oxidized but lab and early field result indicate it is not an issue
  - To date no issues with rutting in the field
How Are The Concerns Being Addressed?

- Affect on baghouse
  - Monitoring high tonnage projects

- Coating
  - Some mixes look poorly coated prior to the silo but at the site are fine
  - Adjusting temperature

- Cooling
  - Properly tarped trucks
  - WMA does not cool at the same rate as HMA
  - Compaction window broader for WMA
How Are The Concerns Being Addressed?

- Activate RAP and RAS binders
  - Field and laboratory studies underway
  - Evaluating blending of virgin and RAP binder for HMA and WMA

- Compatibility with polymer modified binder
  - Test sites constructed
  - Higher temperature than neat mixes

- Expense
  - Offset by energy savings
  - Add RAP
No Distress Apparent after One Year of Service
Another year later…No Distress
Good Longitudinal Joint
Summary of Experience to Date

- Concern: is WMA rut resistant?
  - Less aging of binder during production – not as stiff
- WMA has been rut resistant to date
  - Quick turnover to traffic
  - Accelerated loading
  - Industrial areas
CAUTIONS

- WMA is not a cure all
- Do not assume you can remove one roller
  - Mix dependent
- Properly tuned burners are a must to realize fuel savings
- The lowest temperature a technology can go is not always the best temperature for all mixes
Future of WMA

- Expect it to be a regular tool in your toolbox within the next 2 years
- Texas is running high tonnage projects regularly
  - 30,000 tons to 300,000 tons
  - One district only allows WMA for overlays
COMPACTION

- Is a mechanical process:
- ________ compresses HMA into a smaller denser volume after placement by applying one or more of the 4 forces of compaction
- Increases mixture stability:
- ________ forces asphalt coated aggregate particles closer together
- ________ achieves particle to particle contact
COMMUNICATION

COMPACTION GOALS

- DENSITY
- SMOOTHNESS
- BALANCED PRODUCTION
FACTORS AFFECTING COMPACTION

- MIX DESIGN
- AGGREGATE AND ASPHALT CEMENT
- LAB DENSITY & FIELD DENSITY
- CLIMATIC CONDITIONS
- PAVER TYPE AND PAVING METHOD
- TEMPERATURE: MAT, BASE AMBIENT, DIRECTION OF SUN; WIND
Temperature

80°F Surface & Air Temperature, 5 mph wind

Temperature, F

Time, minutes

Temperature, F

0 5 10 15 20 25 30 35 40 45 50 55 60

0 150 175 200 225 250 275 300

1.5” 2” 3”
50°F Surface & Air Temperature, 5 mph wind
Temperature

30°F Surface, 40°F Air Temperature, 15 mph wind

Temperature, F

Time, minutes
### Major Factors Affecting Rolling Time

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<thead>
<tr>
<th>Factor</th>
<th>Allows MORE time</th>
<th>Allows LESS time</th>
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<tbody>
<tr>
<td>Mat Thickness</td>
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<td>LOW</td>
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<tr>
<td>Base Temperature</td>
<td>HIGH</td>
<td>LOW</td>
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</table>
Compaction of Superpave Mixes

Compactive Force

Pressure Vibration

Pressure Manipulation

Pressure

TENDER ZONE

Temperature Zones

300° - 285°

240° - 200°

170° - 150°
WARM MIX ASPHALT COMPACTION

MIX DESIGN: PG 82-22, POLYMER MODIFIED
WARM MIX PROCESS: SASOBIT ADDED AT THE PLANT
JOB LAYOUT: PAVING WIDTH 12’, PAVING SPEED 25 FEET/MIN., LIFT THICKNESS 21/2 INCH LOOSE
TEMPERATURES: MIXING TEMP. 315 F LAYDOWN TEMP OFF THE SCREED 287-305F
WARM MIX JOB ROLLING PROCEDURES, TEMPERATURE ZONES, # OF PASSES, LENGTH OF ROLLING ZONES, DENSITY ACHIEVED IN EACH ZONE.

- **BREAKDOWN ZONE 66” DOUBLE DRUM VIBRATORY 3000vpm DISTANCE OF ZONE 150’ TEMPERATURE IN ZONE 287-305 F ROLLING PATTERN 5 PASS PATTERN DENSITY ACHIEVED 90%-92%**

- **INTERMEDIATE ZONE 66” DOUBLE DRUM VIBRAYORY 3000vpm DISTANCE OF ZONE 150’ TEMPERATURE IN ZONE 200F ROLLING PATTERN 5 PASS PATTERN DENSITY ACHIEVED 92.4%-94.3%**
WARM MIX ROLLING PROCEDURES

- FINISH ROLLING 66” DOUBLE DRUM OSCILLATING DRUM ROLLER VIBRATE IN STATIC OUT 5 PASS PATTERN 200’ ROLLING ZONE DENSITY ACHIEVED 94.7%-95.6%
TO PREVENT PICK UP ON TIRES
- GET THEM HOT!
COMPACTION BY VIBRATION

- We rearrange the aggregate
- We lock up the aggregate structure
- We leave impact marks in the HMA mat
- We control the spacing of these impact marks, so you will not see or feel them, by matching travel speed & frequency
AMPLITUDE: THE HEIGHT THE VIBRATING MASS MOVES FROM THE MATERIAL BEING COMPACTED-IN ONE ROTATION OF THE VIBRATING MASS.

FREQUENCY: THE NUMBER OF TIMES THE VIBRATING MASS MOVES IN A MINUTE-VIBRATIONS PER MINUTE OR V.P.M.

FREQUENCY AND AMPLITUDE CREATE A GIVEN AMOUNT OF CENTRIFUGAL FORCE.
VIBRATORY IMPACTS PER FOOT IPF

MAINTAIN BETWEEN 10-14 IPF
IPF GIVES US DENSITY, SMOOTHNESS, AND BALANCED PRODUCTION
TIRE SURFACE CONTACT VS. VIBRATORY IMPACT SPACING

1½"

2"

2½"

3"

1" TYP.
## Impact Spacing

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<tr>
<th>Frequency</th>
<th>2 MPH</th>
<th>3 MPH</th>
<th>4 MPH</th>
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TRAVEL SPEED OF ROLLERS

- DOUBLE DRUM VIBRATORY 2-4 MPH
- PNEUMATIC ROLLER 2-3 MPH
- STATIC STEEL WHEEL ROLLER 3-5 MPH

SPEED CAN KILL
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How To Measure Roughness?

- **Equipment**
  1. Straightedge
  2. Inertial Profiler
BASIC PRINCIPLES OF GOOD COMPACTION

KNOW THE VARIABLES
KNOW THE SPECS KNOW THE LAYOUT
ESTABLISH A PATTERN TO ACHIEVE:
COVERAGE, DENSITY, SMOOTHNESS, AND
BALANCED PRODUCTION
KNOW THE BASIC OPERATION OF EACH TYPE
OF ROLLER
CONCLUSIONS:

COMPACTION OF WARM MIX AND HOT MIX ASPHALT FOLLOW BASIC BEST PRACTICE

WARM MIX, DEPENDING ON MIX DESIGN HAS BEEN EASIER TO COMPACT-----AND WE HAVE REDUCED THE # OF ROLLERS, BUT THIS IS THE EXCEPTION