PRODUCTION AND PLACEMENT OF WARM MIX ASPHALT

WMA Webinar

September 19, 2013

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Overview

- Consider mixture characteristics and costs
- Review of materials costs
- Determine the bottom line

Characteristics to Consider

- Ability to carry applied stresses
- Workability – handwork, feathering, compactability
- Lift thickness – t/NMAS ratio, lane drop-off
- Aesthetics - smoothness and texture
- Friction
- Noise
- Durability

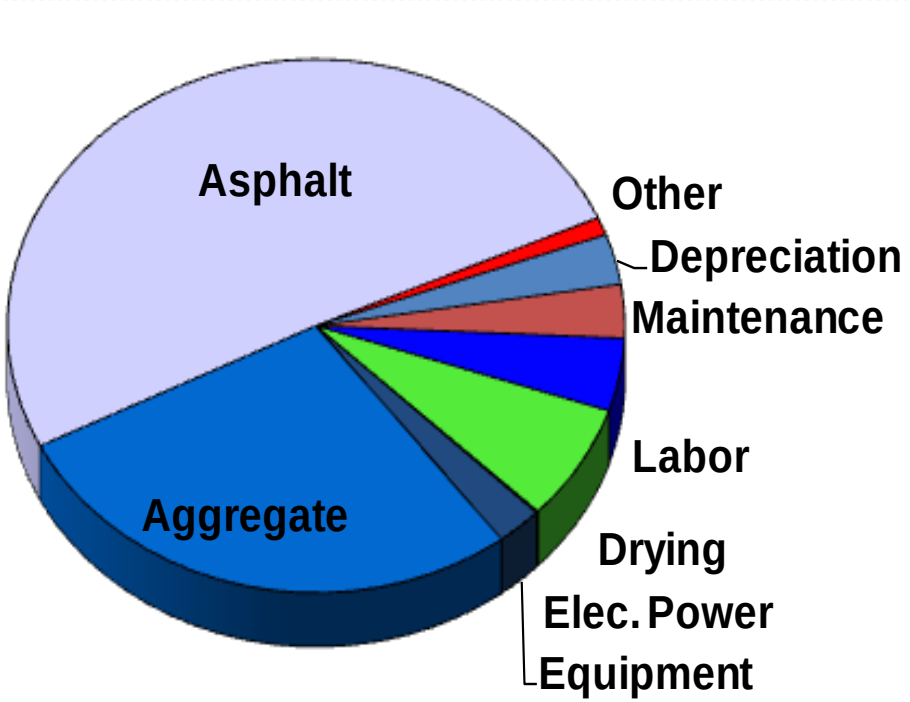
Refer to NAPA IS 128

Costs to Consider

- Cost of component materials
- Equipment rental or depreciation to add components
- Drying costs of materials
- Productivity (tons/hr)
- Haul/delivery costs
- Placement and compaction costs
- Potential of acceptance/pay penalties

Mix Production Costs

Depreciation	$1.24
Maintenance	$1.13
Labor	$1.79
Energy/Drying	$2.87
Electric Power	$0.04
Equipment	$0.97
Aggregate	$11.27
Asphalt	$20.57
Other	$0.44
Total	$40.31



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Purchase Price of Materials

Example

Material	$/ton
#67 stone	12.70
#78 stone	13.50
#89	11.00
Washed #10s	13.00
Natural sand	10.75
Hydrated Lime	160.00
RAP (4.5% binder)	7.45
PG 67-22	410.00

Hidden Costs of Aggregates

- How much water are you buying?
- How much does it cost to dry the aggregate?
- How much material is wasted or lost?
- What is the asphalt demand for the aggregate?

Cost of Dry Aggregate

$/dry ton = ($/wet ton) x (1+w/100)

Example:

5000 tons of W10's purchased from a quarry at $13.00/ton. The W10's had 5.6% moisture at delivery.

$/dry ton = ($13.00/ton) x (1+(5.6/100))

$/dry ton = $13.00/ton x 1.056 = $13.73

Dry inventory = 5000 tons/(1+w/100)

= 4734 tons

Handling Costs, Including Loss

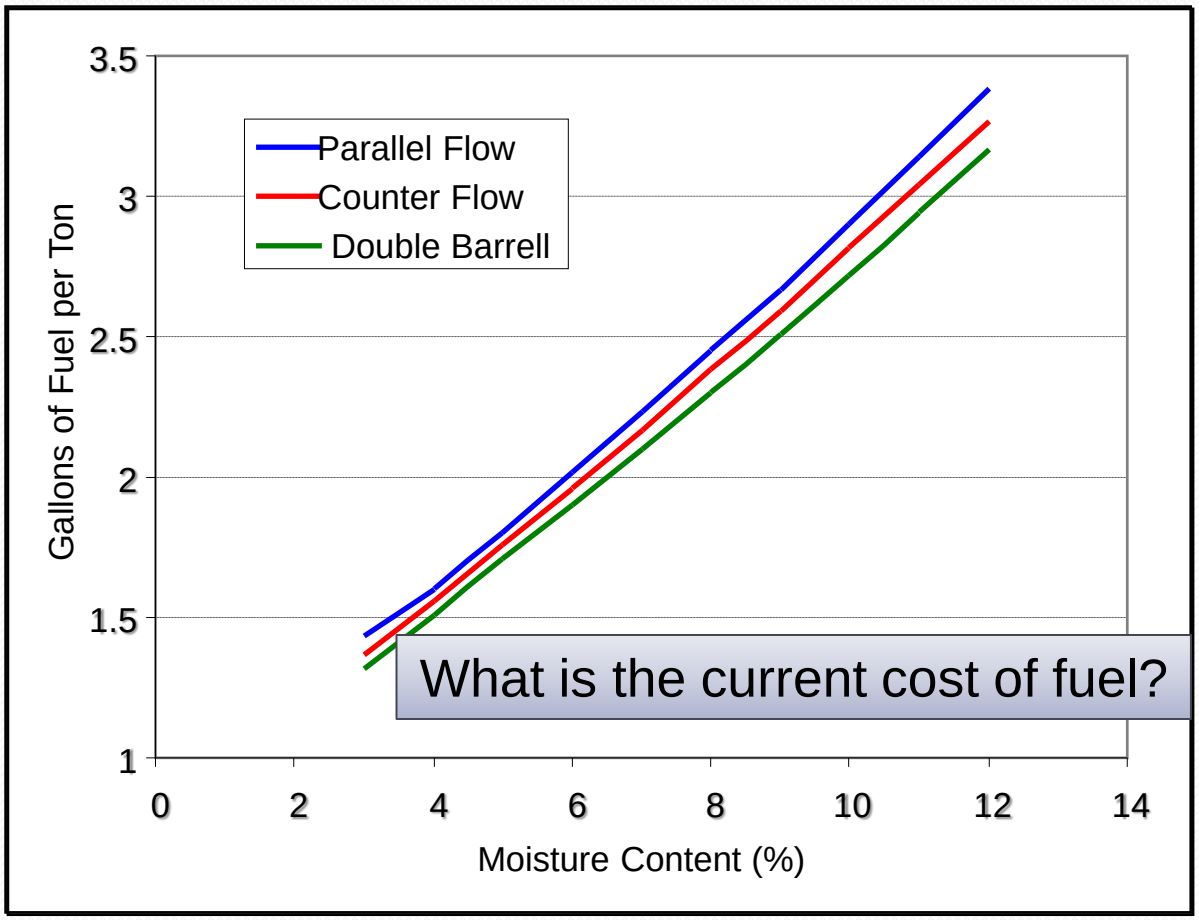
- Handling costs
  - Stockpiling equipment and space
  - Inventory management

- Loss - all materials purchased do not end up in a finished (sold) product
  - Purchased moisture
  - Yard waste
  - Plant waste
  - Theft

Production Costs

- Depreciation
- Maintenance
- Labor
- Drying
- Electric Power
- Equipment

Drying Costs



Astec T-119 Dryer Drum Mixer

Do Covered Stockpiles Payoff?

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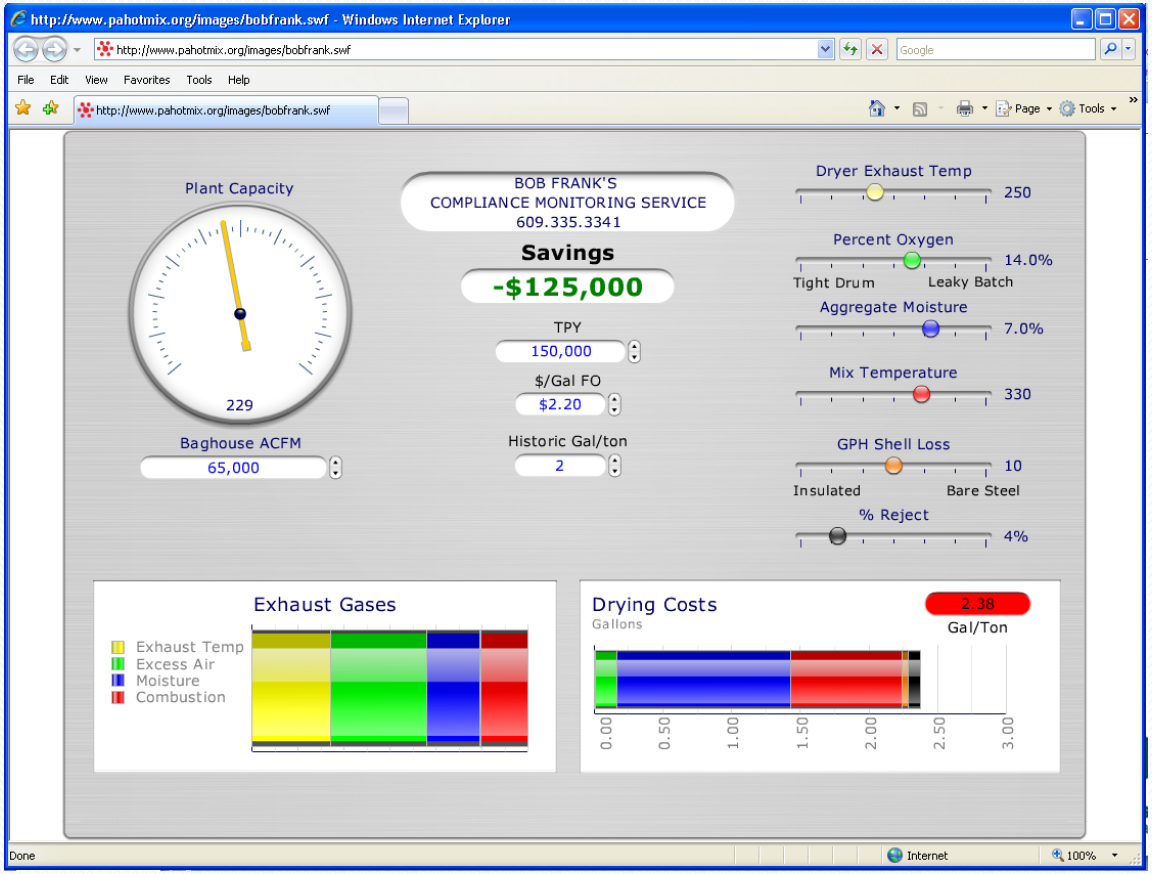
EMU
DUST

Moisture

- 1% increase in moisture increases drying cost by 10 to 12%
- 1% increase in moisture decreases production rate by 11%
- Which material stockpiles retain the most moisture?

Plant Diagnostic Tool

- http://www.pahotmix.org/images/bobfrank.swf



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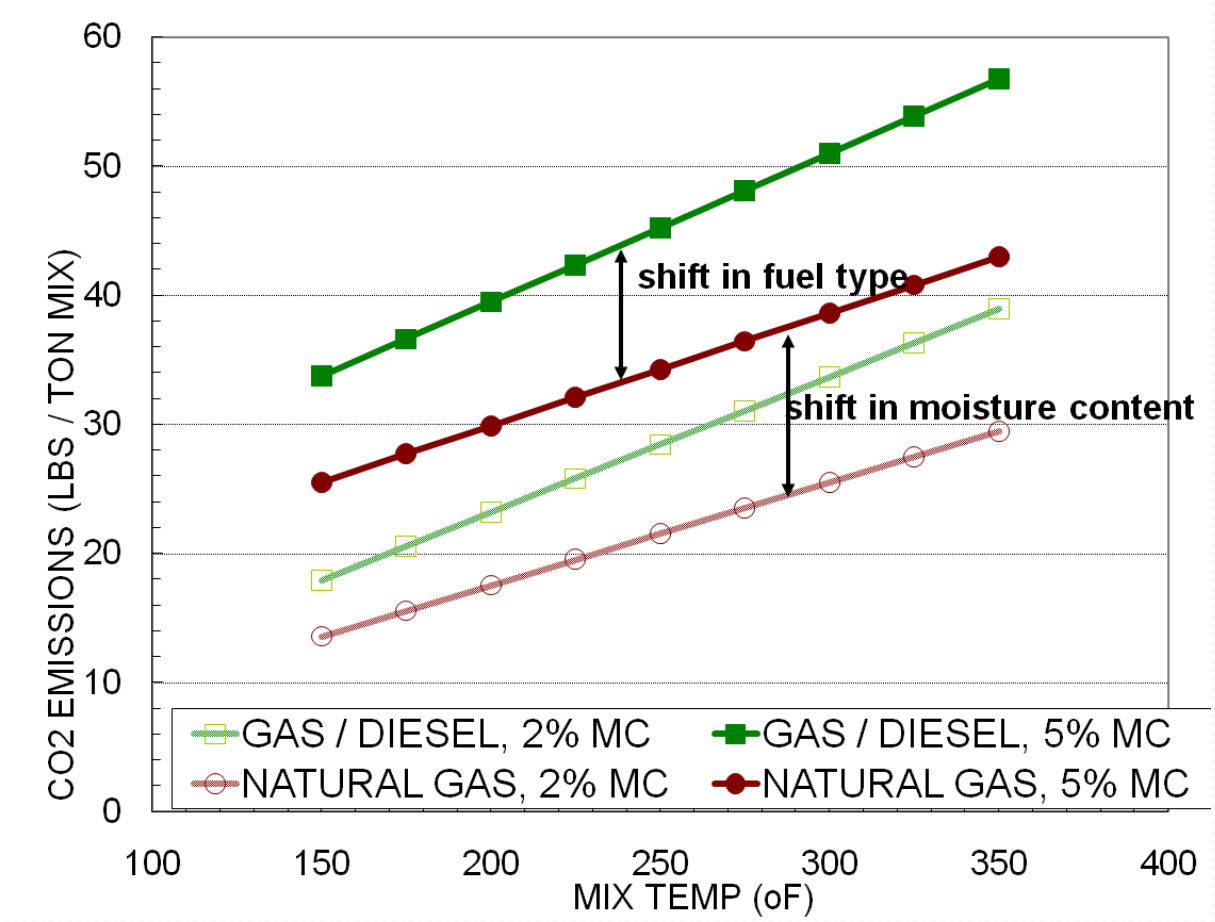
Estimated Reduction in Emissions



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Special Equipment for Additives

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Warm Mix Asphalt

- Cost Additions/Cost Savings: Rules of Thumb
  - Potential Savings
    - Burner fuel
    - Improved in-place density
    - Less wear on plant?
    - Slightly lower asphalt content?
    - Better work environment - improved productivity
    - Higher RAP contents
  - Potential Additions
    - WMA additive
    - Plant modification
    - Anti-strip additive

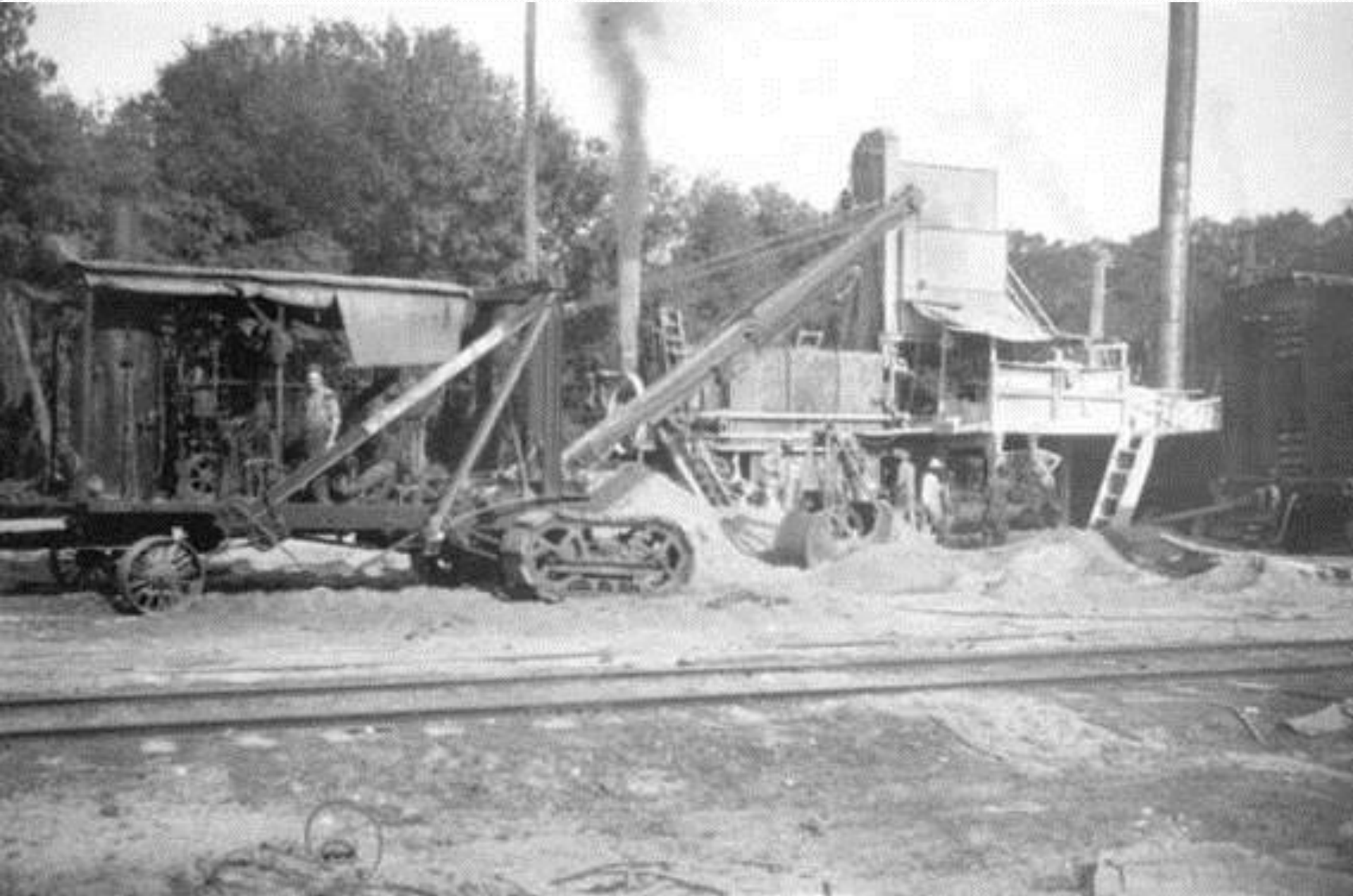
Energy Savings

Based on NCHRP 9-47A field trials:

Avg. fuel savings with WMA = 23%

Production of WMA

- Same plants, may be modified in many cases
- Same hauling and laydown equipment
- Same compaction equipment



Adequate Baghouse Temperatures Must be Maintained

- Low baghouse temperature can cause condensation
  - Corrosion of the baghouse
  - Formation of damp baghouse fines
- Acceptable baghouse inlet temperatures
  - > 220°F for low-sulfur fuels
  - > 240°F for high-sulfur fuels (reclaimed oils)
  - Varies from plant to plant and mix to mix

Maintaining Baghouse Temperatures

- Seal air leaks
- Preheat the baghouse for 15 to 20 minutes
- Inspect fine return lines for buildup
- Occasionally paint corroded interior surfaces with epoxy-based paint

Burner Adjustments

- Burner may need to be tuned to run efficiently at lower temperatures
- Improper burner adjustment can cause the burner to not add enough air to burn all of the fuel
  - Expensive
  - Mix contamination

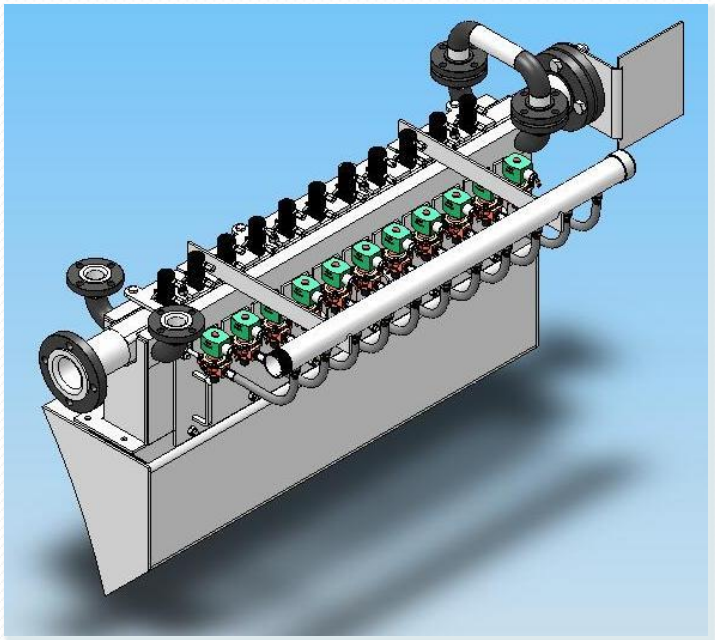
Signs of Unburned Fuel

- Brown film around coated aggregate
- Increased susceptibility to rutting
- Lower dynamic modulus (E*) values
- Increased carbon monoxide (CO) levels
- Fuel in baghouse

Differences with WMA Production

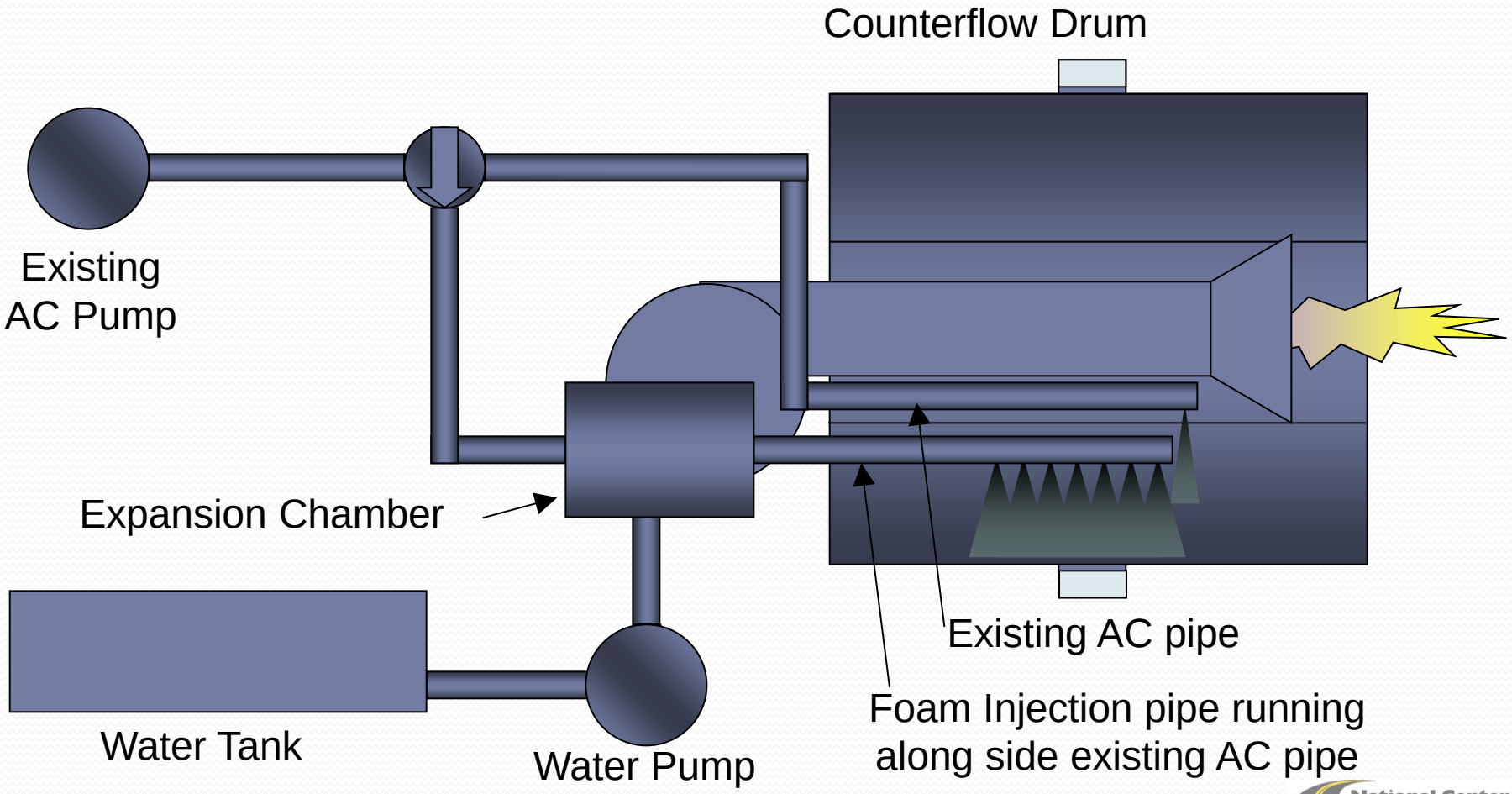
- Addition of the WMA additive or foaming the binder
- Setting the production temperature
  - Start production at normal HMA temperatures, then decrease the temperature to the WMA target

Astec Double Barrel Green Foaming System



- One pound of water per ton of mix, or about two percent of the asphalt flow rate. This is 0.05% moisture in the mix.

Foaming Warm Mix Process



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WMA Dosing

- Refer to product manufacturer for dosage rates
- Ensure injection systems are cleaned and calibrated regularly for accurate dosing

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Removing Moisture

- Increase aggregate retention time
- Insulate dryer shell
- Use variable frequency drive (VFD)
- Reduce stockpile moisture content

Plant Addition of Aspha-min

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Plant Addition of Sasobit

Chemical Additives

- May be added at the asphalt terminal or added at the plant
- Dosage rates depend on the selected additive

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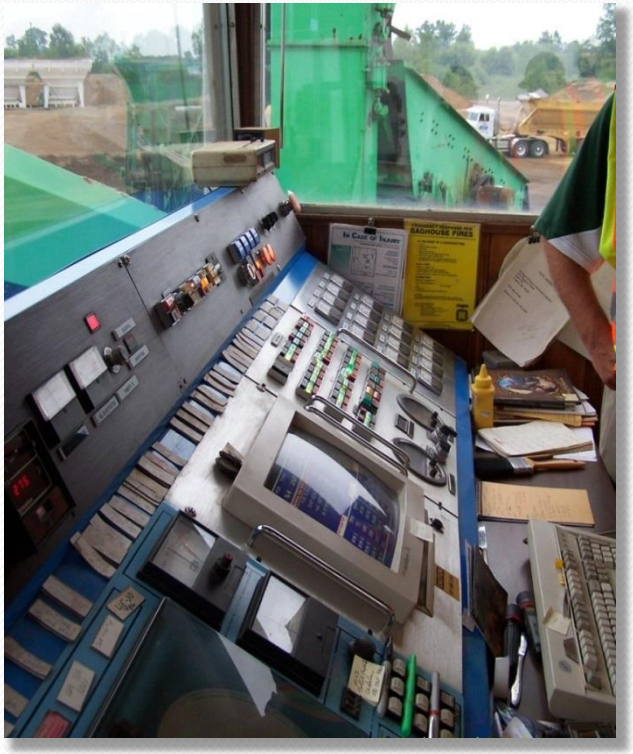
Plant Concerns with WMA

Plant burners may not be properly tuned even for normal HMA production

Incomplete fuel combustion leads to:

- Poor fuel efficiency
- Fuel contamination of the mix (liquid fuels)
- Stack emission problems (CO and THC)
- Potential for a baghouse fire

WMA Production Concerns



- Amperage on motors for drag slat conveyors, coaters, etc.
- Incomplete coating of aggregate

Signs of Incomplete Drying

- Mix Temperature drops more than 20^{o}F from discharge to loadout
- Excessive steam from drag conveyors
- Water dripping from silos

Plant Concerns with WMA

- Condensation in the baghouse could cause:
  - Mudding of the bags
  - Increase draw on exhaust fan motor
  - Formation of corrosive acids with gases from high sulfur fuels

H_2SO_4

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Other Concerns with WMA

- Activation/melting of RAP or RAS binder at lower temperatures
- Additional expense
- One more material/process to control

WMA Mix Test Concerns

- Lower mix temperature results in less aging of the binder that could result in increased:
  - Moisture susceptibility
    - Lower tensile strengths
    - TSRs
  - Rutting potential
    - APA
    - Hamburg
    - Flow Number

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Combining WMA & RAP

- Superheating solves baghouse problem without plant modification or efficiency loss
- Superheating assures virgin aggregates are dried
- Provides the greatest economic and environmental benefit

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Combining WMA and RAP

- WMA technologies can improve the ability to properly coat aggregates and RAP during production
- Lower production temperatures will reduced plant aging of binders which may allow for increased use of RAP without grade bumping

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Rate of Cooling Variables

- Layer Thickness
- Air Temperature
- Base Temperature
- Mix Laydown Temperature
- Wind Velocity
- Solar Flux

Example Paving Temperature Decrease

Hot Mix 314 °F

138.1 pcf

Aspha-min Mix 254 °F

138.5 pcf

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Better Work Environment

- Studies to quantify fumes have shown that WMA:
  - Reduces Total Organic Material > 90%
  - Drops Benzene Soluble Matter below detectible limits

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Better Temperature Uniformity

- The key is getting density and getting it uniformly

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Compactive Effort

- WMA has been seen to require less compactive effort even with the lower temperatures
- Changes may need to be made with WMA due to higher densities
  - Change rolling pattern
  - Decrease binder content
- Check with non-destructive device calibrated to cores

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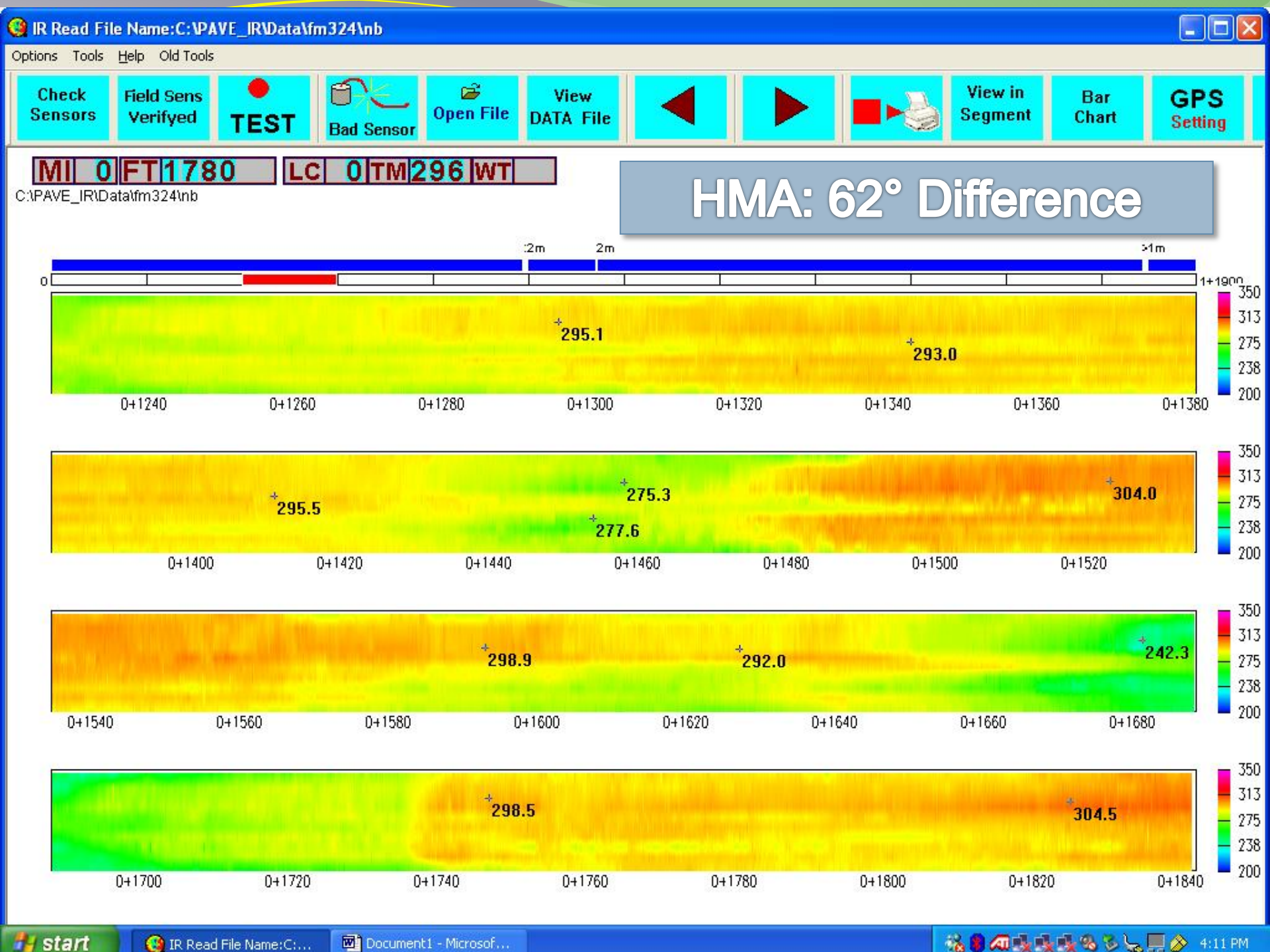
Temperature Segregation

- Temperature differentials in the mat can cause density problems.
  - Temperature differentials exceeding 30°F can cause an 80% reduction in fatigue life (NCAT).
  - TTI recommends keeping temperature differentials below 25°F.

Infrared (IR) Bar

- Collects and displays pavement temperatures across the mat.
- Allows for corrections to improve overall uniformity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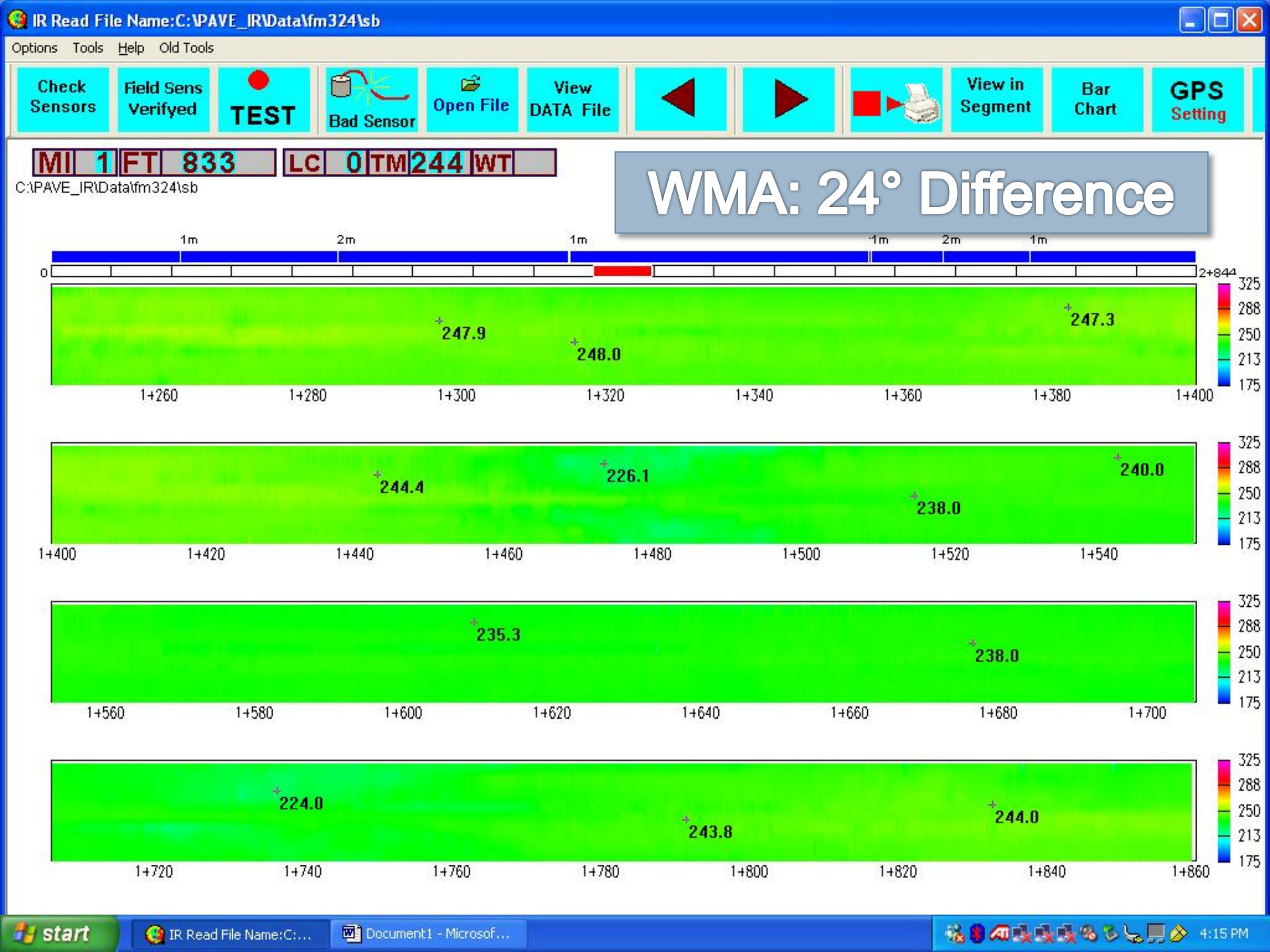
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Making Field Adjustments to Mixes

- It is almost a certainty that any mixture will require some adjustments to meet acceptance targets (air voids, asphalt content, etc.)
- Differences between the lab mix design and plant produced mix can be caused by:
  - Changes in the aggregate properties
  - Breakdown of aggregate through the plant
  - Incomplete drying
  - Surges in baghouse fines return
  - Differences in aging and absorption
  - Inaccurate plant calibration
  - Different laboratory equipment
  - Different technicians

Making Field Adjustments to Mixes

- Maintain current data on stockpile gradations. This will provide a heads up on changes from the mix design.
- Make sure plant is “leveled out” before taking a mix sample. For most plants, this takes about 80 to 100 tons.
- Conduct tests to determine Pb, gradation, Gmm, and Gmb

WMA is not a cure for bad construction practices!

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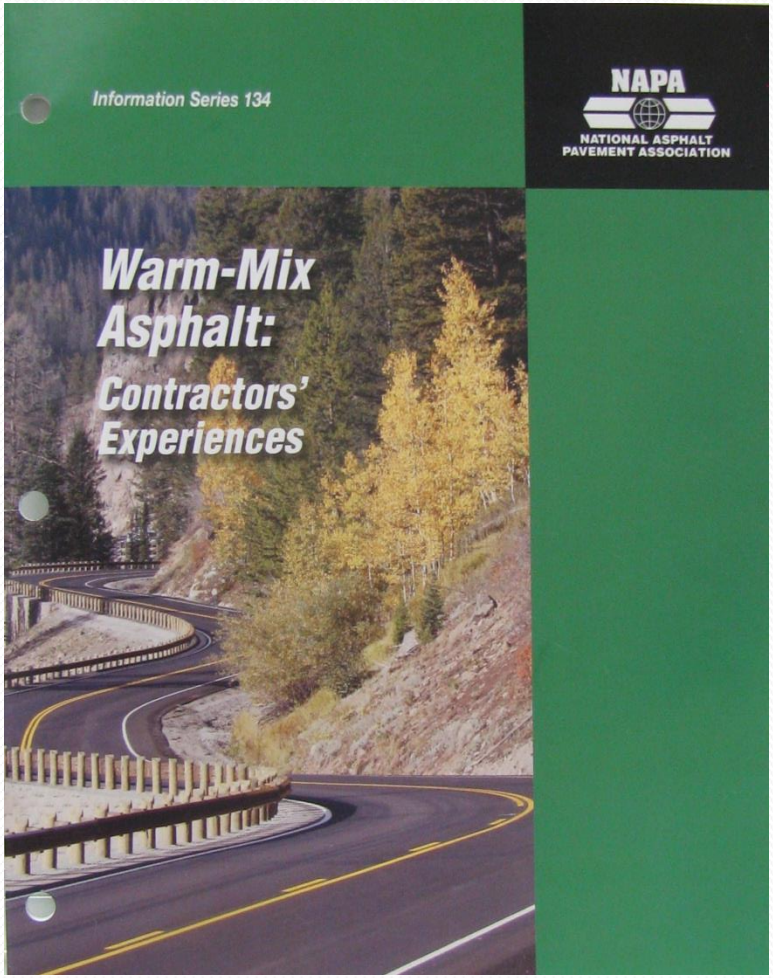
Additional Resource



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