WARM MIX ASPHALT

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Introduction to WMA and its benefits

- "Warm-mix asphalt is the generic name of technologies that allow the producers of hot-mix asphalt pavement material to lower the temperatures at which the material is mixed and placed on the road." (www.hotmix.org)

- Multiple technologies to lower production and placement temperatures of conventional hot-mix asphalt

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Introduction to WMA and its benefits

- Numerous benefits (due to cooler temperatures)
  - Reduced plant emissions
  - Reduced burner fuel usage
  - Pave in cooler weather
  - Haul mix for longer distances
  - Higher levels of density
  - Higher RAP contents

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WMA experiences in Kentucky

- 2008 (≈ 160,000 tons)
  - 3 projects on I-65, 2 on I-75
  - Water-injection system on two plants
  - Evaluated WMA on shoulder applications first
  - Coating issues
  - Tender characteristics leading to inconsistent density and poor ride quality
  - Prolonged tenderness

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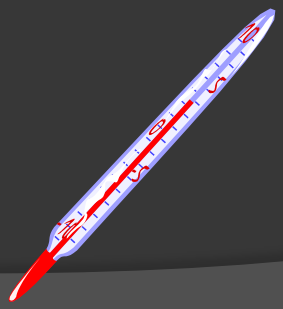
WMA experiences in Kentucky

- 2009 (≈ 930,000 tons)
  - Permissive WMA specification
  - Tailored toward water-injection/asphalt foaming process
  - Trial demonstration for each asphalt mixing plant
  - WMA (PG 64-22) mixing temperature = 230 to 275ºF
  - WMA (PG 64-22) compaction temperature = 210 to 275ºF



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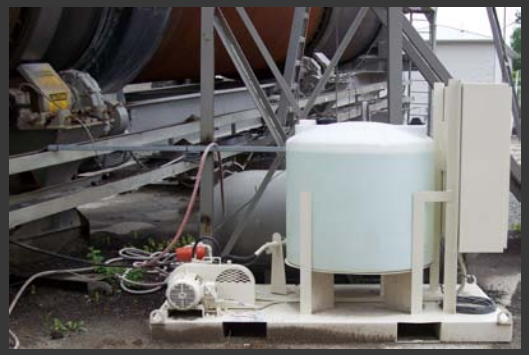
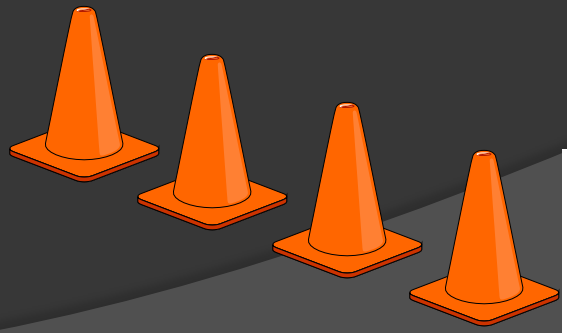
WMA experiences in Kentucky

- 2009 (≈ 930,000 tons)
  - Research project with Kentucky Transportation Center underway
  - One experimental WMA project involving wax additive
  - Overall, WMA production and placement operations were successful





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WMA experiences in Kentucky

- 2010 (≈ 980,000 tons)
  - Numerous experimental WMA projects involving wax and chemical additives (≈ 90,000 tons)
  - Approximately 18 total asphalt mixing plants approved for water-injection/asphalt foaming
  - Volumetric properties and core density comparable to HMA

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WMA experiences in Kentucky

- 2011
  - Probably exceed 2010 tonnage (> 1 million tons)
  - 27 total asphalt mixing plants approved for water-injection/asphalt foaming (five different systems)
  - One contractor voluntarily producing WMA with chemical additive

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RESEARCH RESULTS - WARM MIX ASPHALT IN KENTUCKY

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The Basics

- Asphalt is made of two parts
  - Aggregate and binder
- Binder is “thick”
  - Viscosity = Fluid “Thickness”
    - Water has a low viscosity
    - Honey has a higher viscosity
    - Binder has an even higher viscosity

What is Warm Mix?

- Binder has to be thinned out
  - Must fully coat the aggregate
  - Traditionally done by heating
  - Warm Mix uses non-thermal methods to decrease binder viscosity
- Aggregate gets coated at cooler temperatures
  - Wax, chemical, or water additive

Potential Benefits

- Contractor
  - Money saved on fuel costs could offset material costs
  - Could lead to longer paving season
  - Longer haul distances open up new markets
- Client/Agency
  - Longer-lasting asphalt
  - Fewer rehabs
- Public
  - Fewer cracks = smoother pavement
  - Fewer rehabs = fewer delays
  - Better for the environment

Therefore…

- If the pavement lasts longer
  - Then leads to fewer rehabs
- If fewer rehabs
  - Then pave more miles of road with limited funds
- Bottom line
  - WMA provides the opportunity to get better roads with your current budget.

What we did...

- Visit 9 asphalt resurfacing projects
  - 5 - Chemical Additive (Evotherm 3G)
  - 3 - Wax Additive (Sasobit)
  - 1 - Wax section and chemical section

- Test and Control Sections
  - HMA control section – construction as usual
  - WMA test sections – only change made was inclusion of additive in the binder

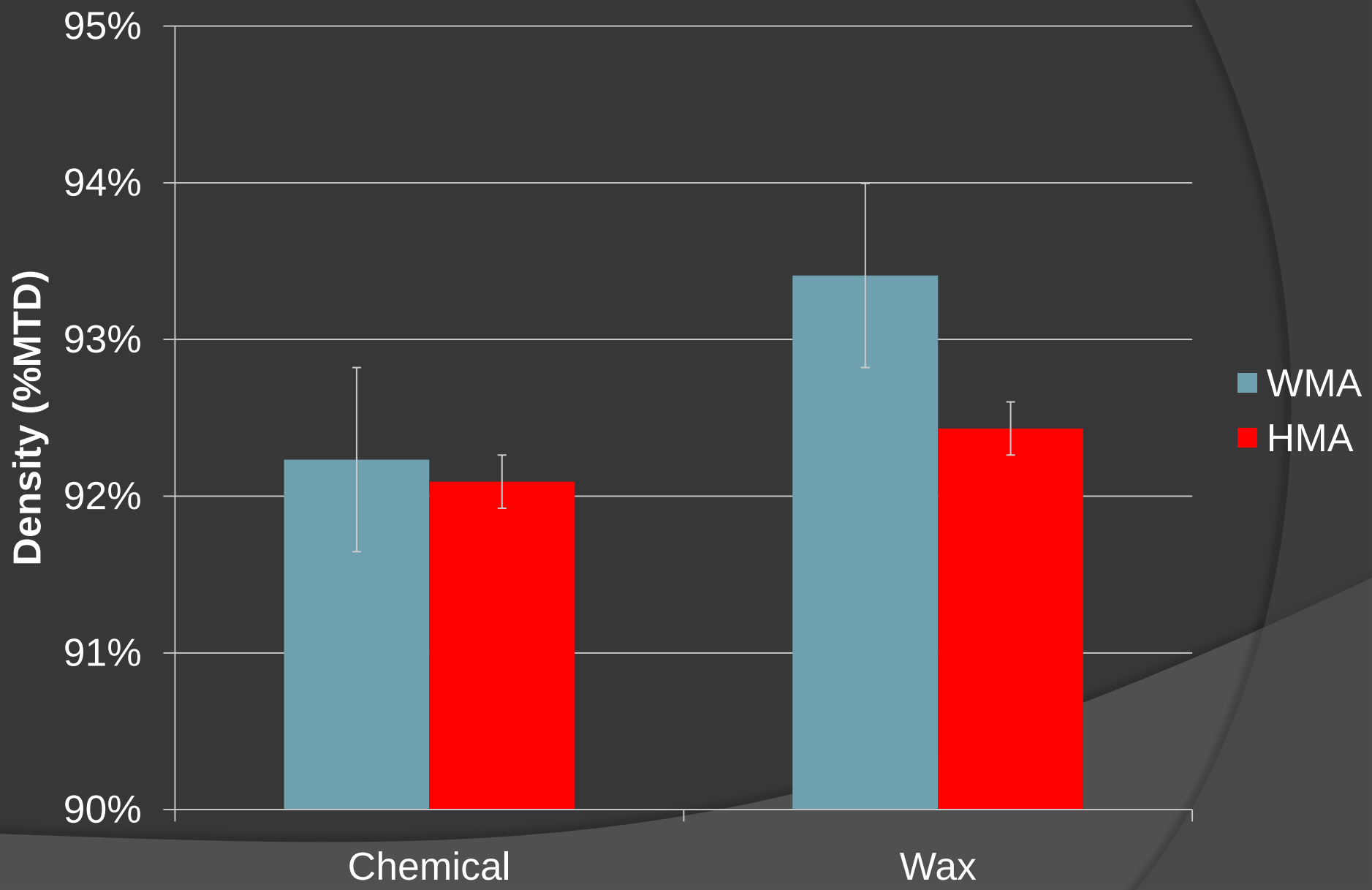
What we did...

- Select test locations
  - Cut cores, measured in-place density, measured permeability at multiple points throughout each section.
- Monitored temperature throughout production/placement process.
  - Warm Mix was placed on average 50-60°F cooler than hot mix for these projects.

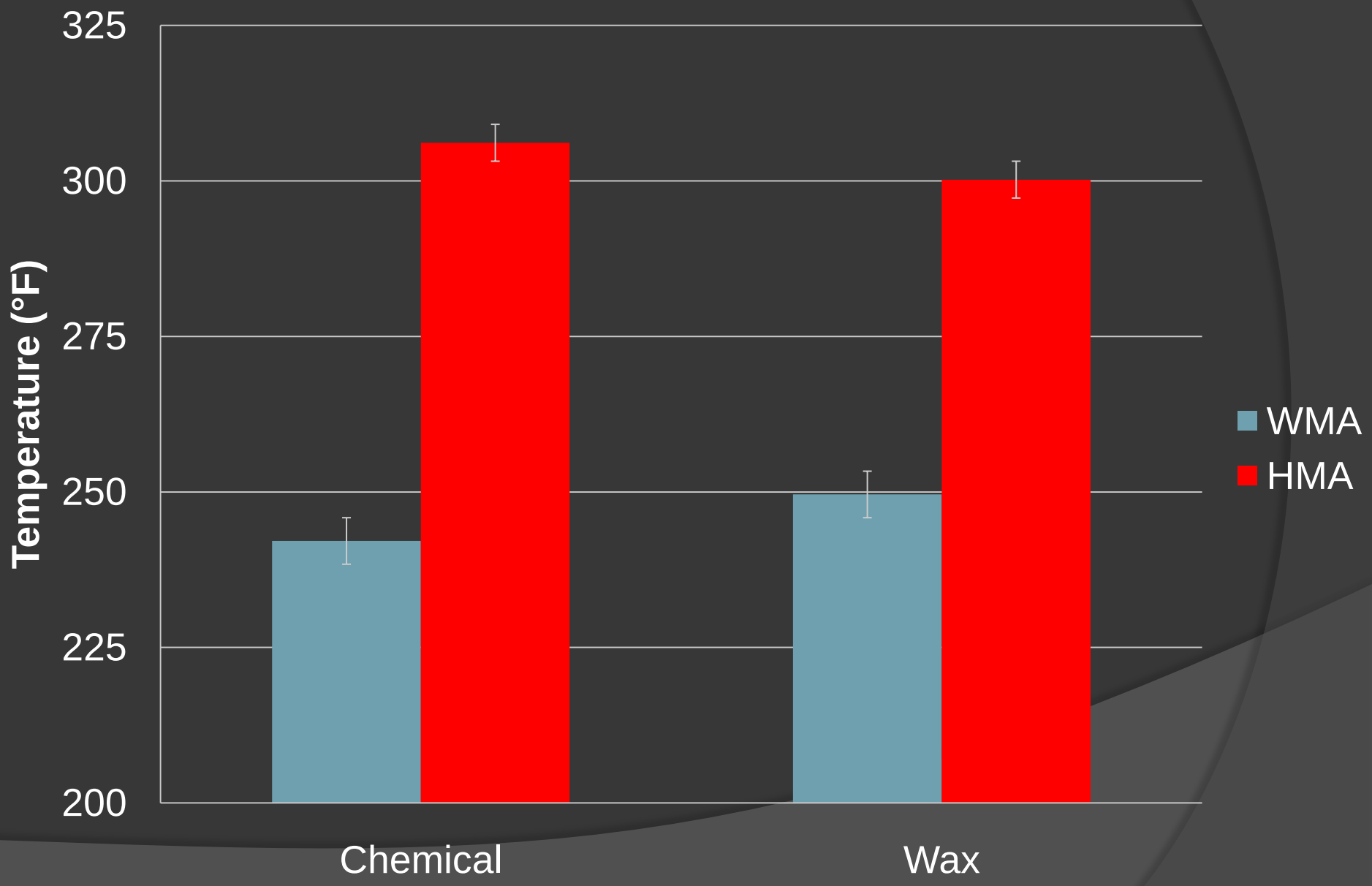
Keep in Mind…

- Quality of warm mix MUST be as good or better than HMA, or it is NOT acceptable.
- ↑ Density = ↑ Performance
- ↓ Temperature = ↓ Fuel Cost
- ↓ Temperature = ↓ Cracking
- Addition of WMA additive was ONLY change in mix

Average Density, All Projects (% MTD)



Average Temperature Behind Paver, All Projects (°F)



WMA – Behind the Paver

Foamed Warm Mix

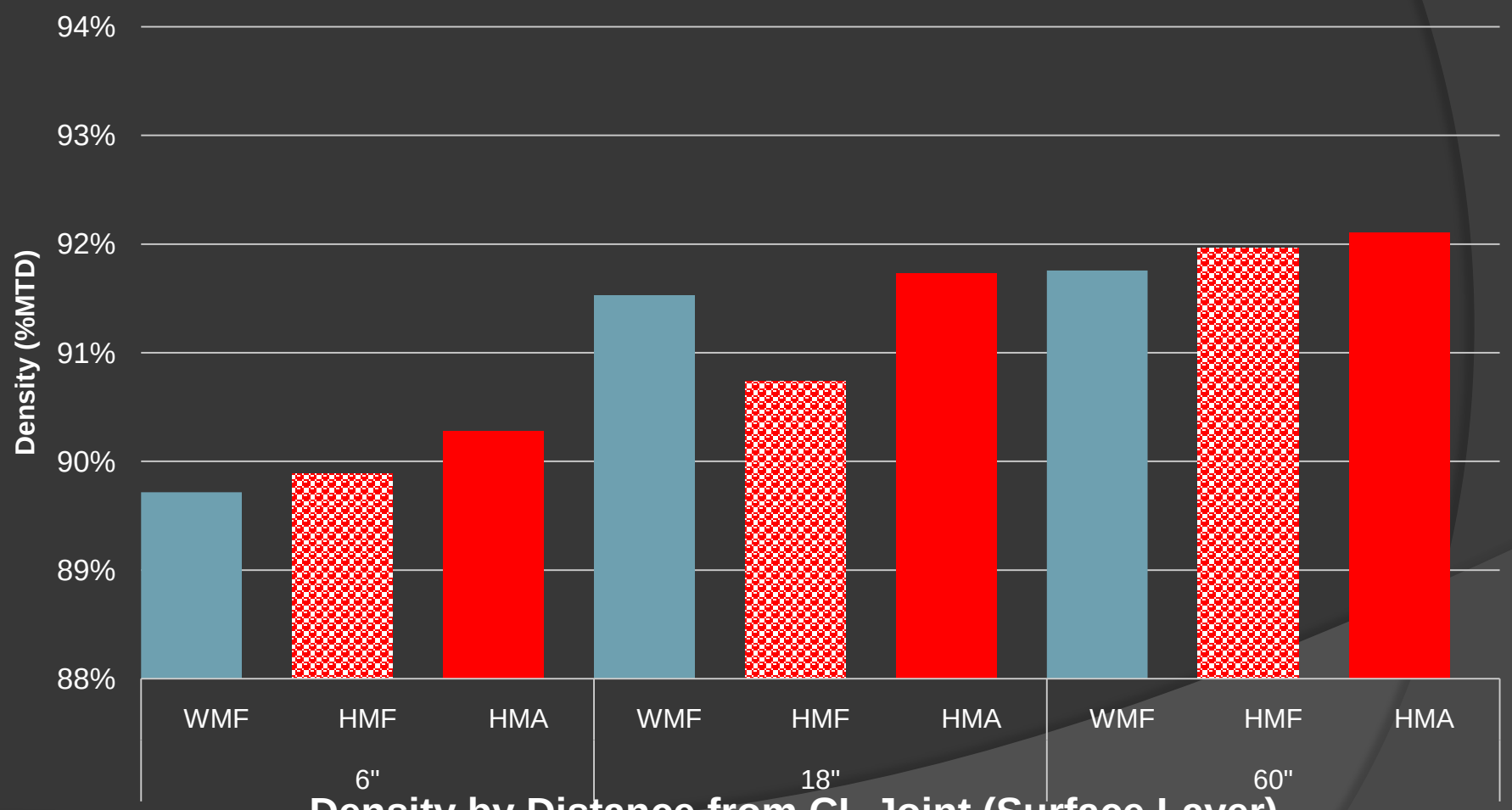
- Compared three mixes
  - Traditional Hot Mix (290°F)
  - Foamed Warm Mix (260°F)
  - Foamed Hot Mix (290°F)

- Can foaming process be used at HMA temperatures as a compaction aide?

Foamed Warm Mix

- Monitored density and temperature
- How would foamed hot mix density compare to other asphalt types?

Surface Placement of Warm Mix Foam, Hot Mix Foam, and Hot Mix Asphalt (not foamed)

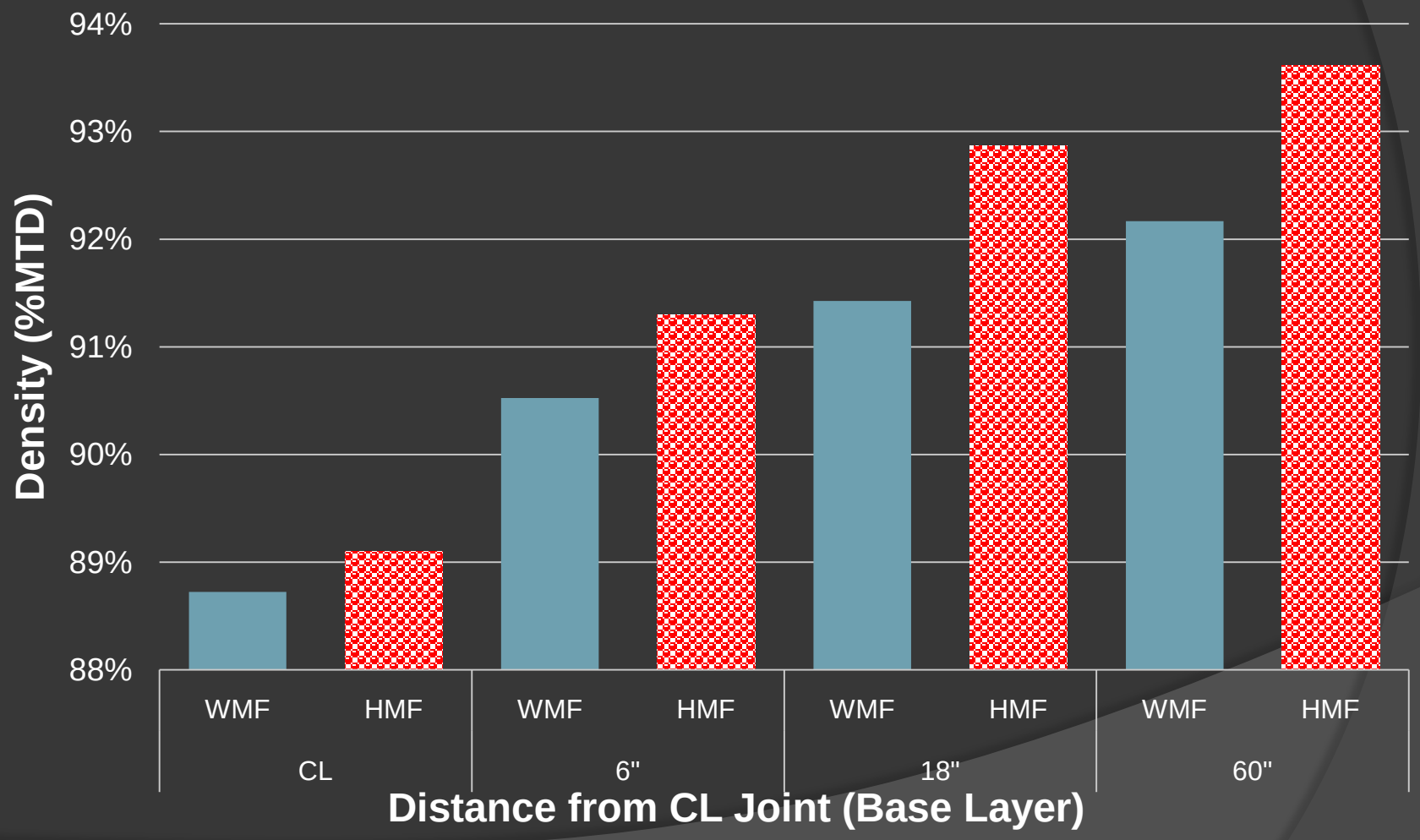


Density by Distance from CL Joint (Surface Layer)

Conclusions – Surface Layer

- Surface showed no significant difference in density
  - Data indicates increase in temperature gave no compaction benefit
- Increased oxidation – Not good
- Increased fuel costs – Even Worse

Base Placement of Warm Mix Foam (WMF) and Hot Mix Foam (HMF)



Conclusions – Base Layer

- Base showed increase in density at hotter temperatures
  - Could indicate compaction aide in thicker layers
- 30°F Increase produced 1% density increase.
  - Economic decision left to asphalt producer

Conclusions

- WMA densities were as good or better than their HMA counterparts.
- WMA temperatures were on average 60°F cooler than HMA control sections.
- Actual savings will depend on plant efficiency, fuel prices, additive costs, aggregate moisture, etc.

Questions?

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