



Warm Mix Asphalt – What is it and how can we benefit?

Danny Gierhart, P.E.
Regional Engineer – Asphalt Institute

SE States Pavement Association Management and Design Conference
Southeast Pavement Preservation Partnership Meeting

May 11 - 13, 2009



WMA - What is it?

- Plant mix asphalt produced at lower temperatures while maintaining the workability required to be successfully placed

Thermometer reads 228.1°F

asphalt institute



How does it work?

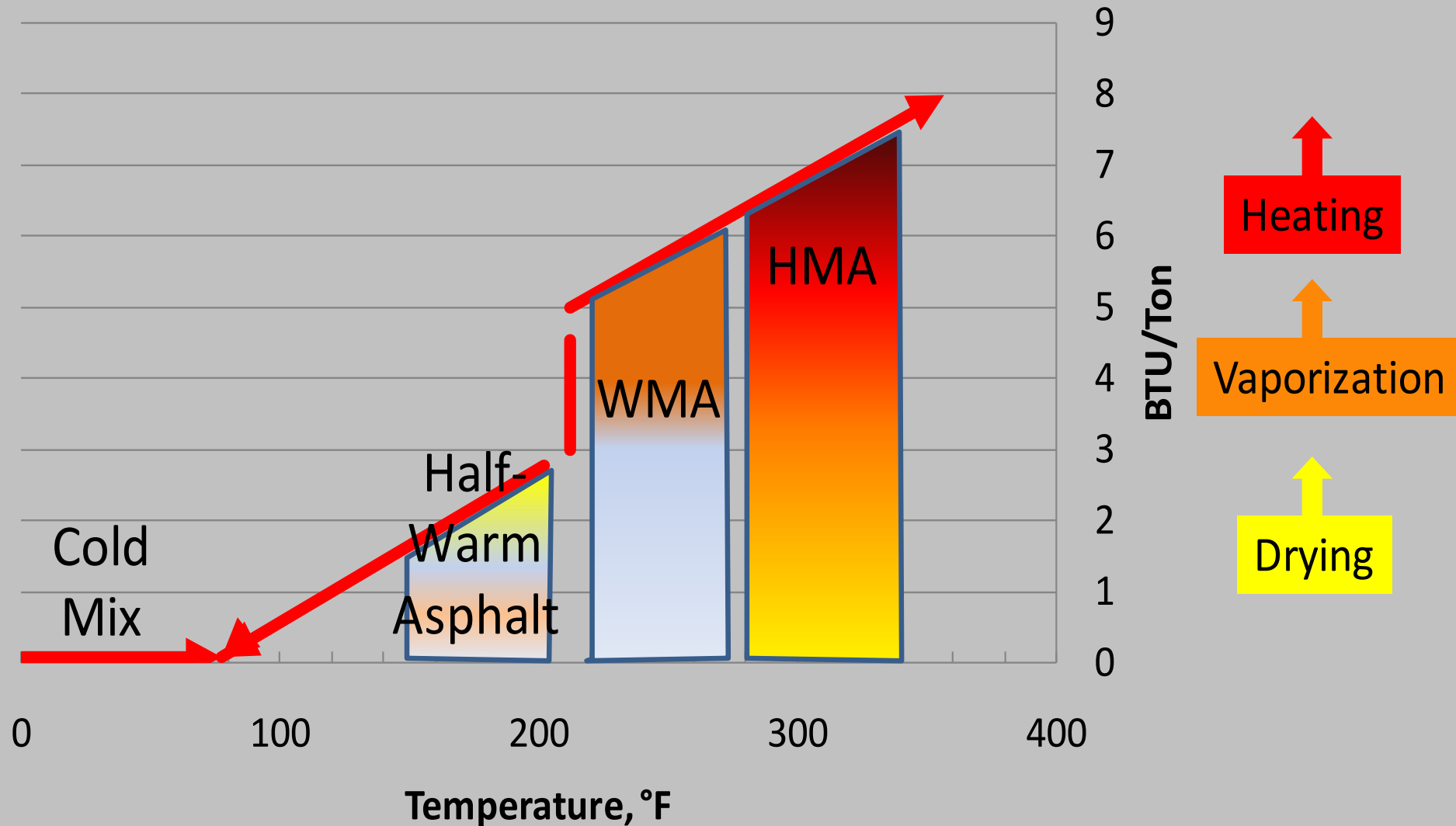
- Although there are several different WMA technologies and products, the basic function is to reduce the viscosity of the binder at lower temperatures to allow for sufficient coating of the aggregates, maintain good workability and durability
- A variety of additives and/or processes have been developed to make this possible

Several ways to classify WMA technologies

- One is by temperature reduction
 - Hot Mix Asphalt > 275 °F (135 °C)
 - Warm Mix Asphalt > 212 °F (100 °C)
 - Half-Warm asphalt mixtures < 212°F (100 °C)

Classification by Temperature

asphalt institute



Classifying WMA by technology:

- Processes that use some form of additive
 - Processes that use water
 - Processes that use both water and additive
- or -**
- Processes that foam the asphalt
 - Processes that chemically modify the asphalt

A *partial* list of technologies

Foaming Methods

- Advera – *PQ Corp.*
- Double-Barrel Green - *Astec*
- Green Machine - *Gencor*
- AQUABlack - *Maxam*
- WMA System – *Terex*
- Low Emission Asphalt – *Suit-Kote*

Chemical Modifiers*

- Evotherm - *MeadWestvaco*
- Rediset – *Akzo-Nobel*
- Revix – *Mathy-Ergon*
- Sasobit - *Sasol*

Processes that introduce small amounts of water

- May be injected via a foaming nozzle
- Or may use a hygroscopic material such as zeolite
 - Blended with the dry aggregate
 - Releases water at elevated temps over time
 - Creates a controlled foaming effect which lasts until the temperature drops below 212°F (100°C)
- When the water turns to steam:
 - It expands by a factor of 1,673
 - Expands & cools the asphalt
 - Reduces the viscosity.
 - Amount of expansion varies depending
 - amount of water added
 - temperature of the binder

Plant modifications for foaming

asphalt institute



Maxam AQUABlack



Terex Warm Mix Asphalt



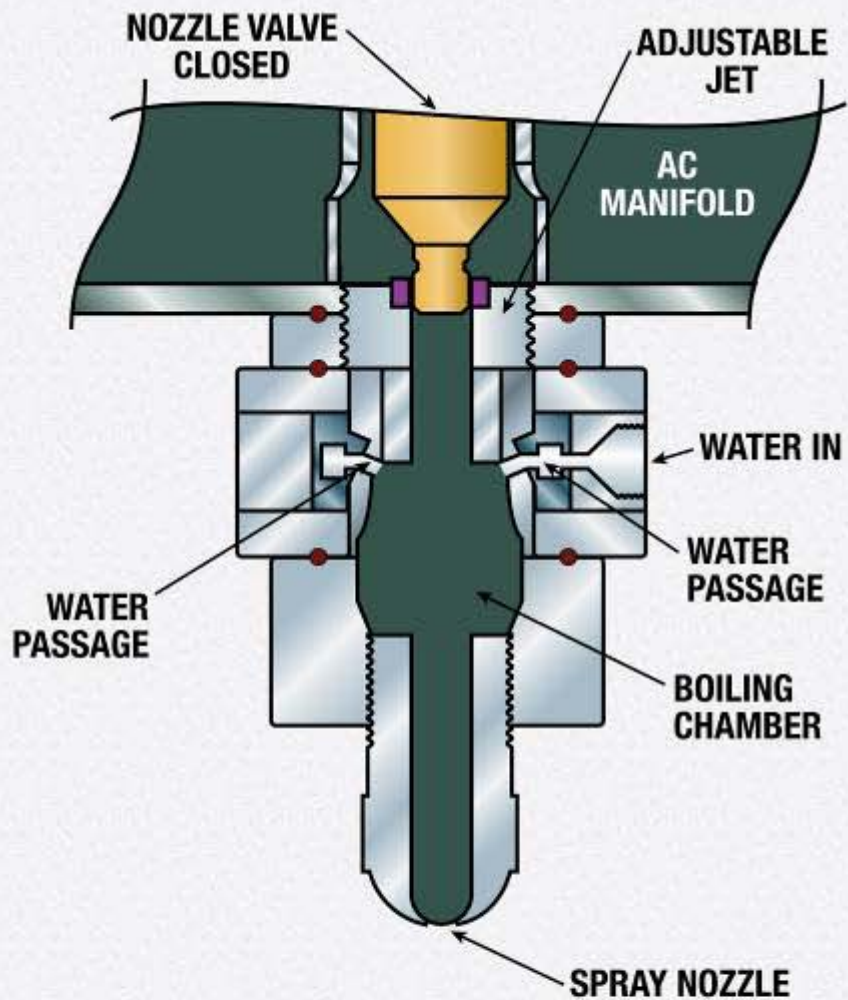
StanSteel Accu-Shear



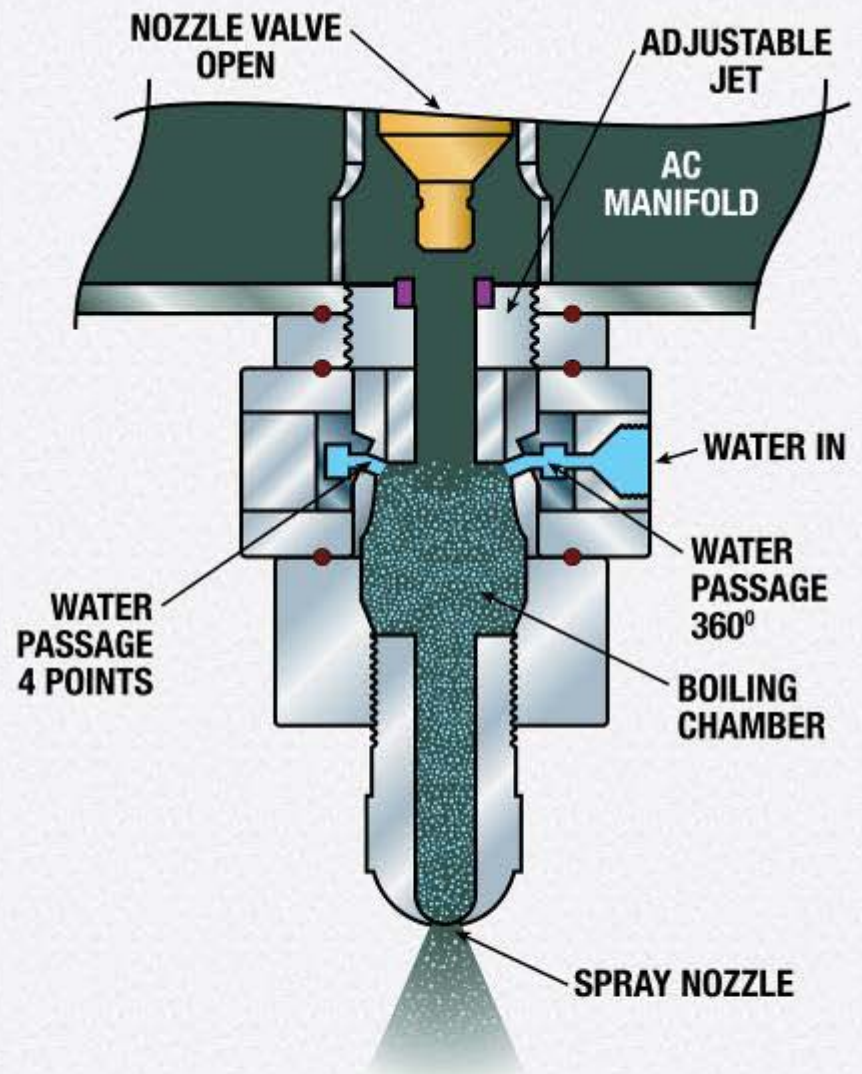
Gencor Green Machine



Astec Double Barrel Green



FOAM NOZZLE CLOSED



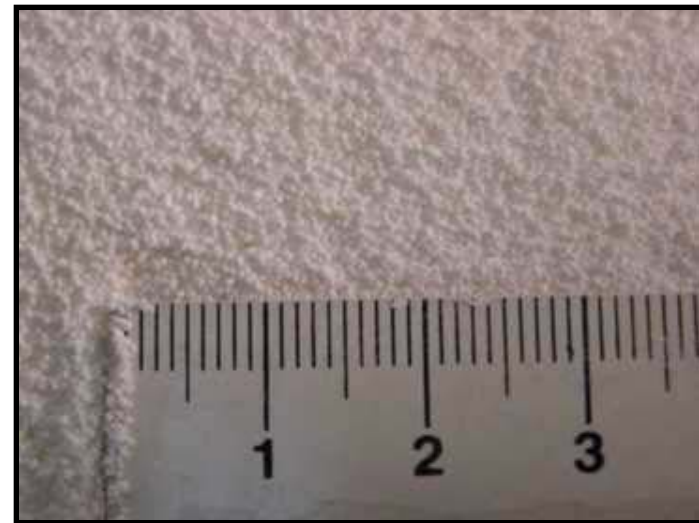
FOAM NOZZLE OPEN

FOAM NOZZLE

Additives for foaming



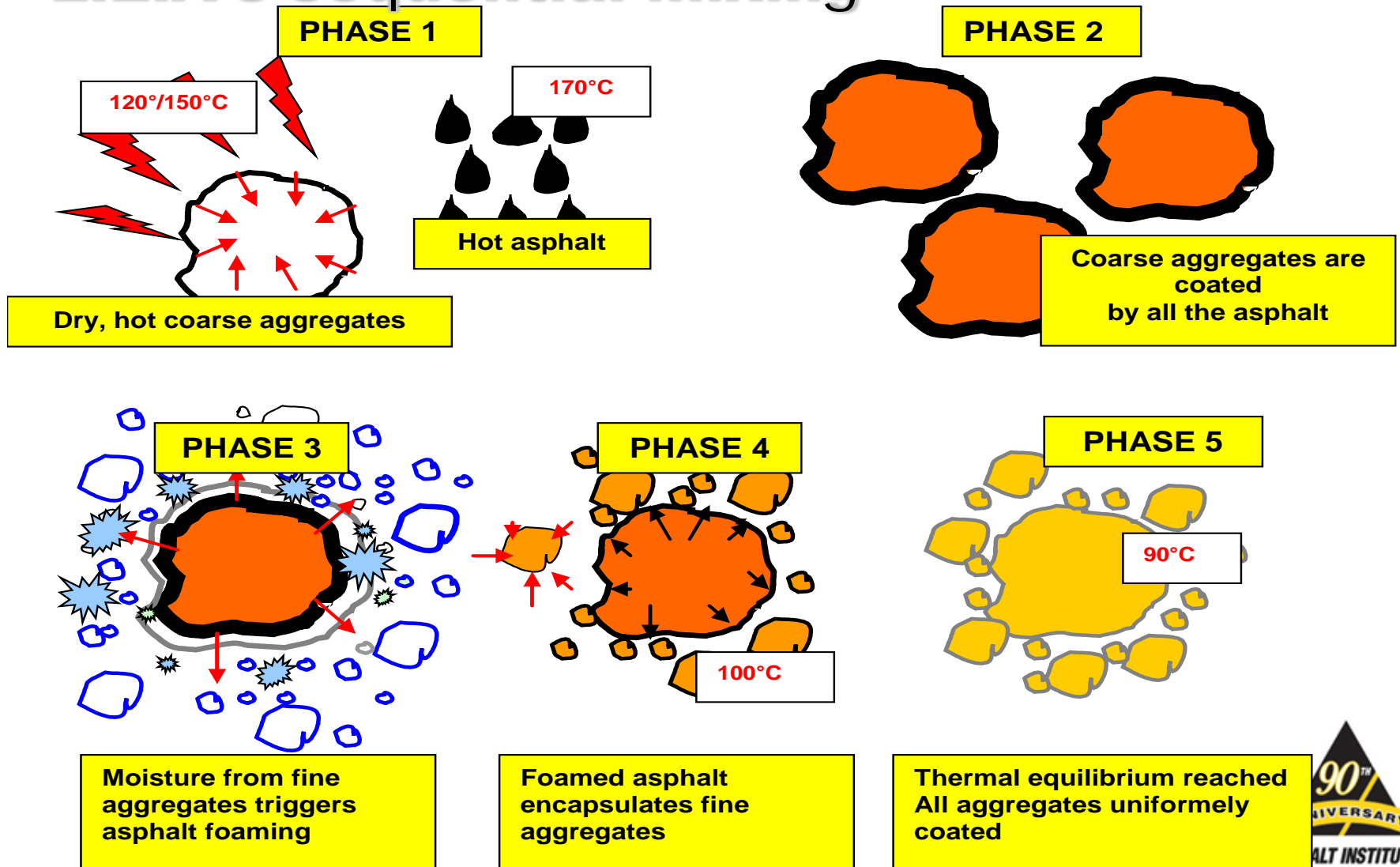
**PQ Corporation -
Advera Zeolite Powder**



**Eurovia / Hubbard Group
Aspha-Min Zeolite Powder**

Foaming Process - LEA

L.E.A's sequential mixing



Chemical Process - Evotherm

Emulsion Based



- Evotherm™ – MeadWestvaco
 - Emulsion mixed with hot aggregates
 - Mix temperature between 185 to 240 °F
 - The emulsion uses a chemical package
 - to enhance coating, adhesion, and workability.
 - Water in the emulsion flashes off as steam
 - A new process has been developed called DAT,
 - Same chemical package
 - Diluted with a small amount of water
 - Injected in-line just before the mixing chamber.

Chemical Process - Evotherm

asphalt institute

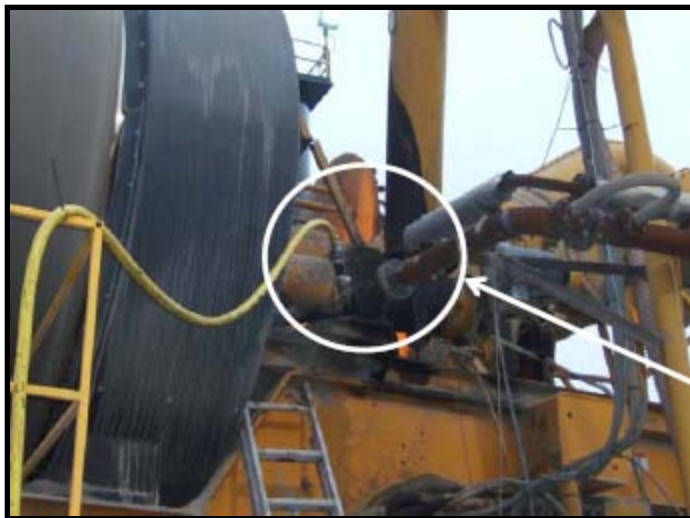


Additive

MWV EVO THERM
WARM MIX ASPHALT TECHNOLOGY



Volumetric Pump



**Asphalt Line
Injection Point**

Chemical Process - Sasobit

Wax Based

- Sasobit[®] Technology – Sasol Wax
 - Sasobit wax melts at 212°F
 - Completely soluble in binder
 - Reduces the viscosity of the binder
 - Increases the resistance to deformation throughout the operating temperature range
 - Does not affect the low temperature properties of the binder



Chemical Process - Rediset

- Added to binder at about 1 kg per ton of mix
- No plant modifications required
- Does not introduce moisture into mix
- Includes anti-stripping adhesion promoter
- Improves cohesive strength
- Does not affect the temperature properties of the binder



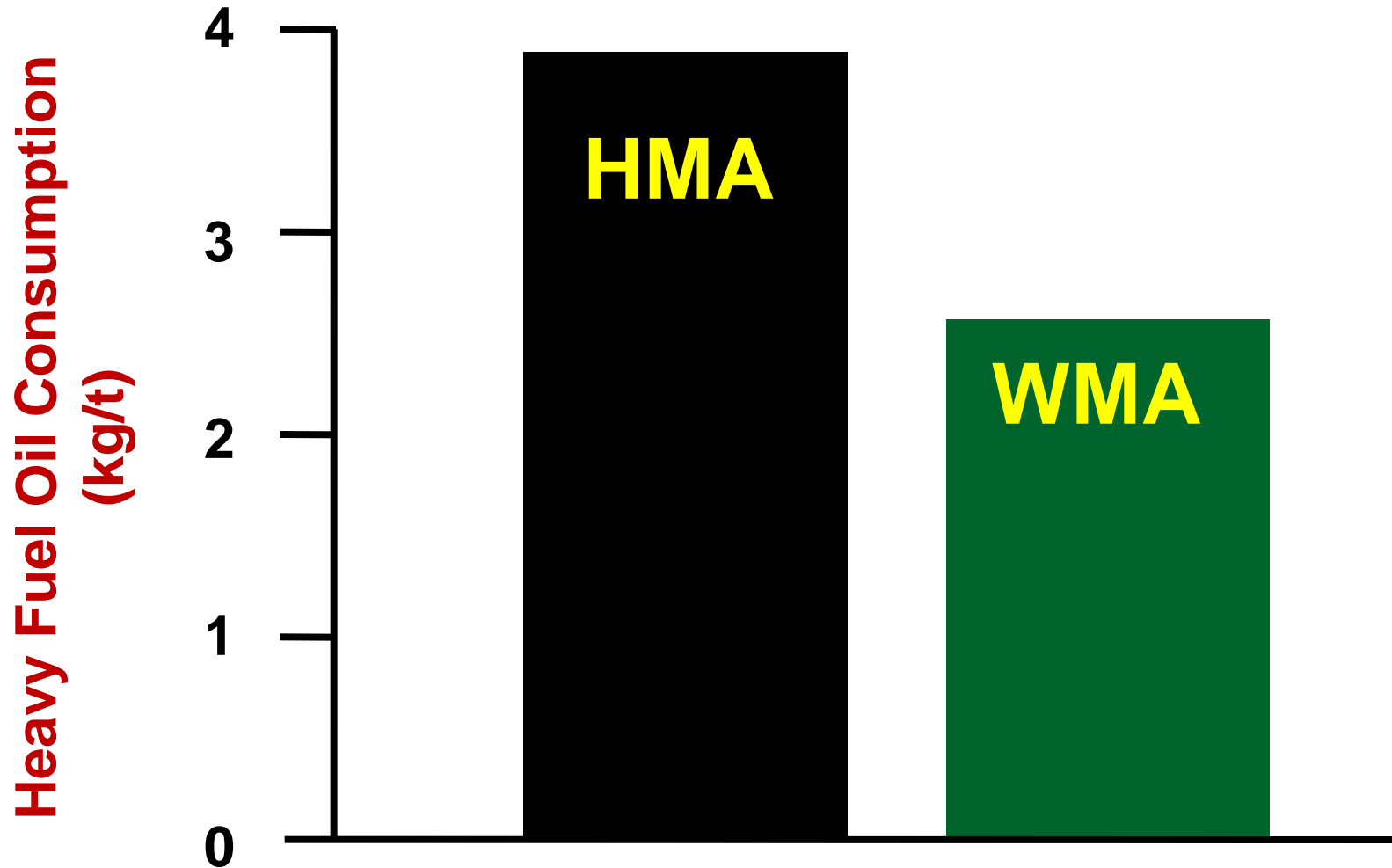
How can we benefit?

asphalt | institute



Lower energy consumption (~30%)

asphalt institute



Lower fumes and emissions (~30-90%)

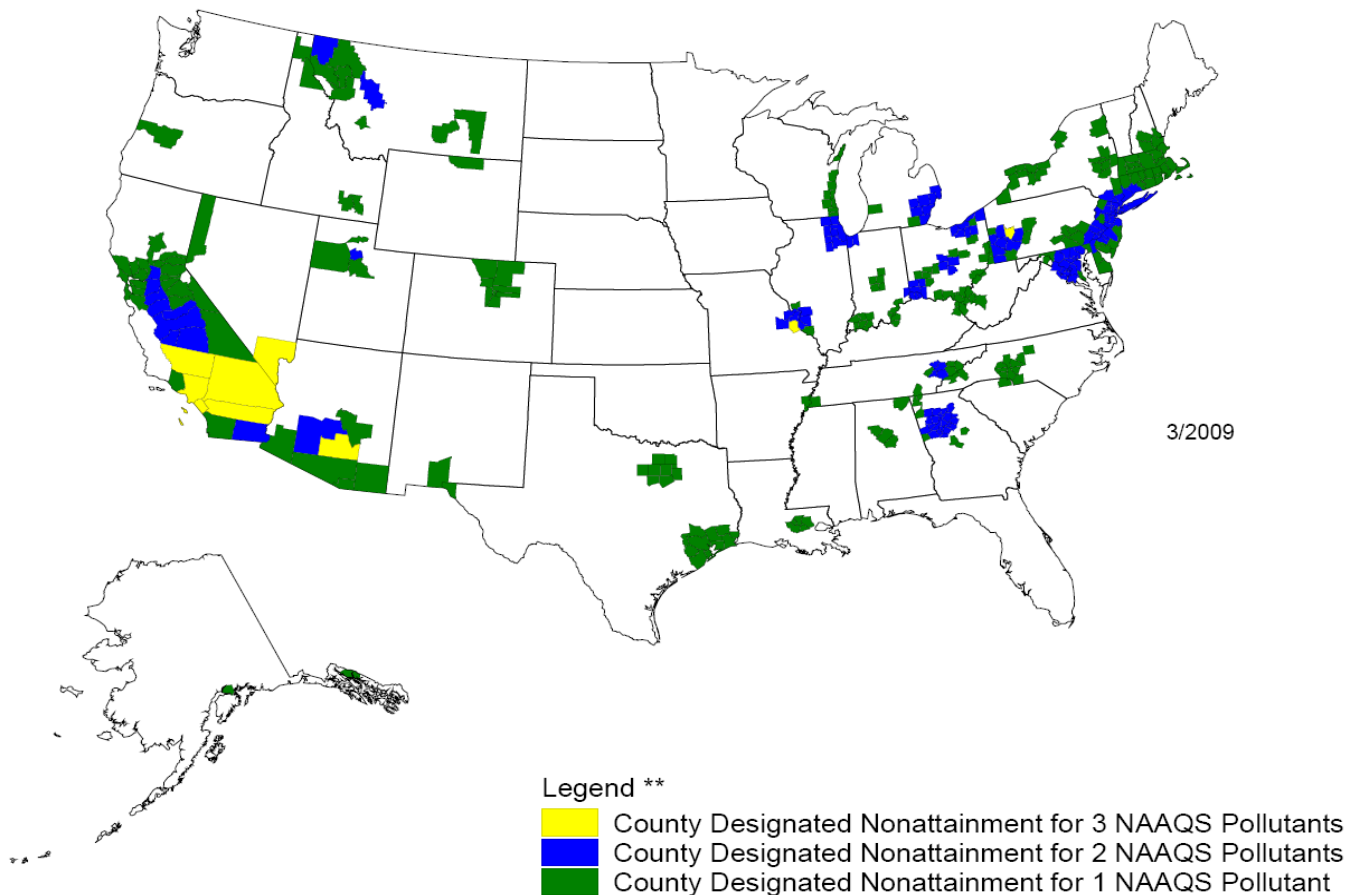
asphalt institute



Areas of the country where air pollution levels persistently exceed the national ambient air quality standards may be designated "nonattainment."

Counties Designated "Nonattainment"

for Clean Air Act's National Ambient Air Quality Standards (NAAQS) *



* The National Ambient Air Quality Standards are health standards for lead, carbon monoxide, sulfur dioxide, ground level 8-hr ozone, and particulate matter (PM-10 and PM2.5). There are no nitrogen dioxide nonattainment areas.

Environmental Advantages

Every WMA technology reduces emissions compared to HMA

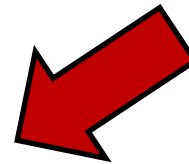
- **Figures specific to Evotherm:**
 - ✓ **Reduces job site emissions by up to 97%**
 - ✓ **Reduces greenhouse gasses at least 60%**
 - ✓ **Nearly 75% reduction in photochemical smog emissions**
 - ✓ **> 80% drop in acid rain causing sulfur dioxide**

Better Working Conditions for Workers (Lower Fumes, Temperature)

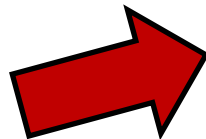
asphalt institute



**HMA Control
Section**



**WMA
Section**



Makes obtaining proper roadway compaction easier

asphalt | institute

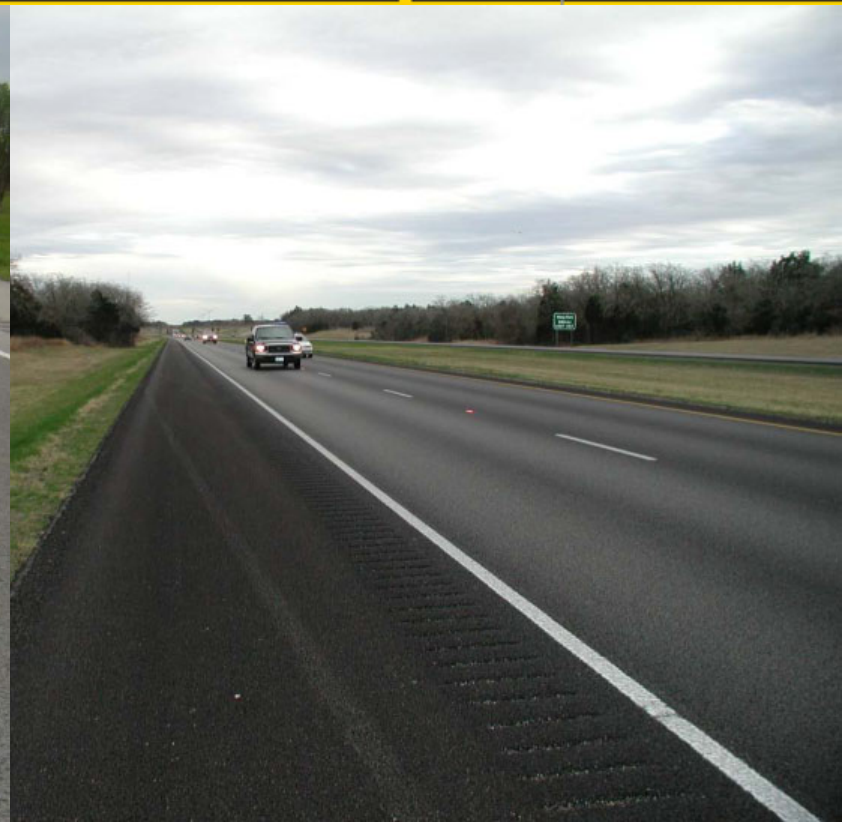
*Most specifications heavily weight Density,
e.g. AASHTO R 42*

Combined Pay Factor =

$$0.20PF_{\text{BINDER}} + 0.35PF_{\text{VOIDS}} + 0.10PF_{\text{VMA}} + 0.35PF_{\text{DENSITY}}$$

Decreased binder aging, light oils never reach boiling point (285°F)

asphalt | institute



Pavement stays blacker, longer



Extended paving season / night paving / longer hauls

asphalt | institute



Absorbs less into the aggregate, allowing for a greater effective binder content

asphalt institute

Warm Mix →

Hot Mix →



What about moisture susceptibility?

TSR Data from I-70 WMA Project in Colorado

- **Control Mixture TSR = 85%**
(Dry ITS = 67 psi, Wet ITS = 57 psi)
- **Advera Mixture TSR = 81%**
(Dry ITS = 69 psi, Wet ITS = 56 psi)
- **Sasobit Mixture TSR = 84%**
(Dry ITS = 76 psi, Wet ITS = 64 psi)

***Other projects have experienced lower TSRs on WMA, however**

What about rutting susceptibility?

Hamburg Rut Test Data* from Same Project

- **Control Mixture – 3.9 mm rut**
- **Advera Mixture – 3.5 mm rut**
- **Sasobit Mixture – 2.9 mm rut**

*** Specimens run under water at 40 °C, values after 20,000 passes**

TxDOT Hamburg Rut Specimens – HMA vs. WMA after 1 year of service

asphalt institute



Allows for increased usage of RAP

asphalt institute



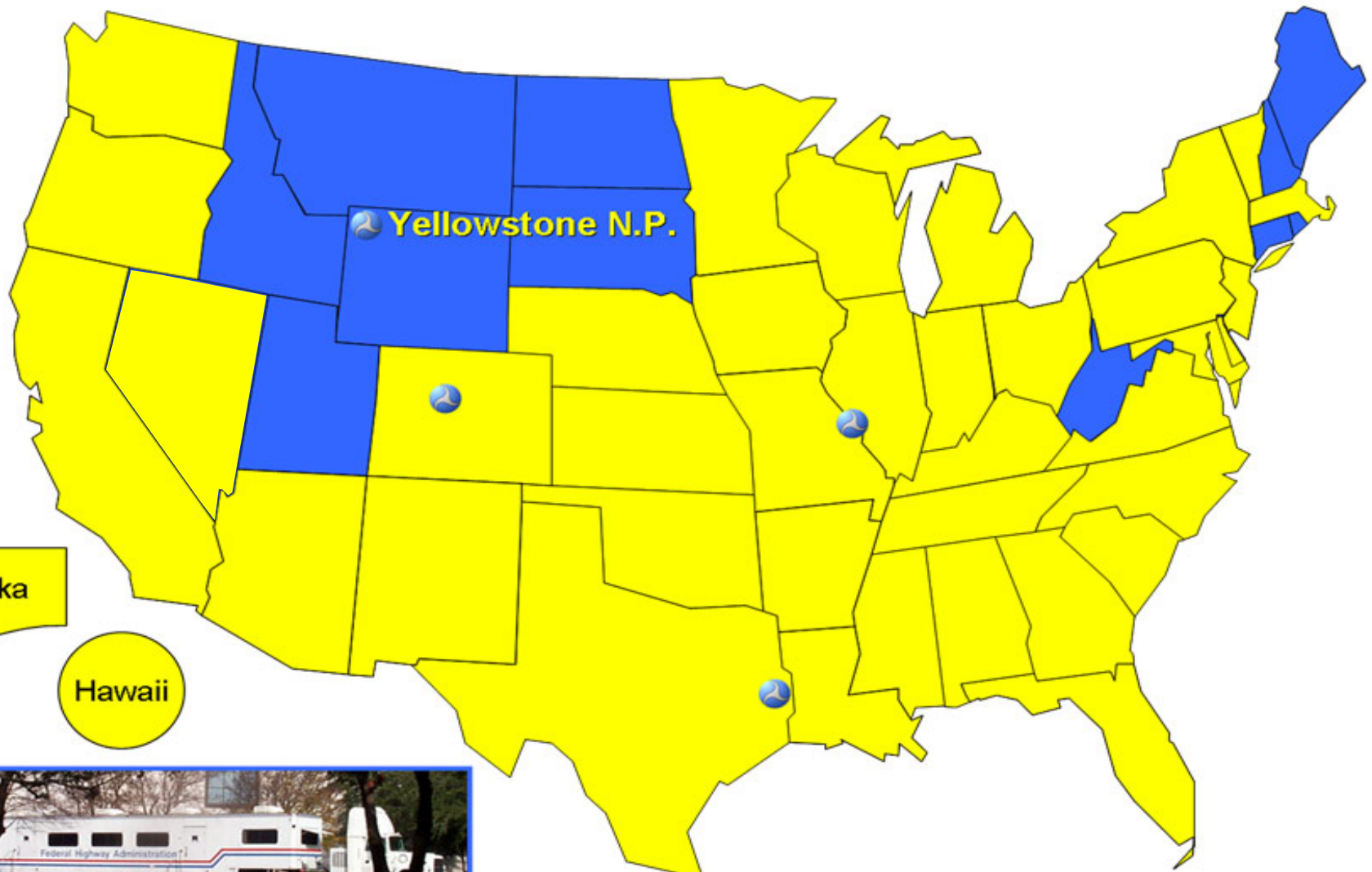
Eliminates bump when paving over crack sealant

asphalt institute



WMA Projects / Demos

asphalt | institute



Questions?

asphalt institute

