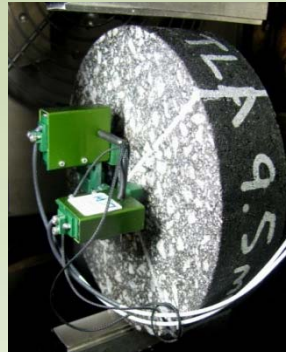




at AUBURN UNIVERSITY

Warm Mix Asphalt Introduction and Processes

Ray Brown



Overview

- Definition of WMA
- WMA Categories
- Use of WMA in the US
- Advantages of WMA
- Opportunities & Challenges with WMA



One WMA Definition

A green product that lowers
manufacture and laydown
temperatures by 30° to 100°F.



Another WMA Definition

Asphalt Mixture produced at
temperatures less than 275
degrees F

SASOL
reaching new frontiers



**KOLO
VEIDEKKE**

2003



Shell
Thiopave

 **PQ Corporation**

MWV
EVO THERM
WARM MIX ASPHALT TECHNOLOGY


ASTEC
INDUSTRIES, INC.


MAXAM™
Maxam Equipment, Inc.

SASOL
reaching new frontiers


Lea-co


 **KOLO VEIDEKKE**

 **TEREX®**

WMA
warmmixasphalt.com

 **ACCU-SHEAR™**


GENCOR GREEN

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LEAD CAP



EUROVIA
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AkzoNobel
Tomorrow's Answers Today


ENGINEERED ADDITIVES LLC


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MEEKER


NEW WARM MIX

National Center for
Asphalt Technology
NCAT
at AUBURN UNIVERSITY

WMA Categories

1. Organic Additives
2. Chemical Additives
3. Asphalt Foaming Technologies
 - a. Foaming additives
 - b. Water Injection Systems
4. Combinations of above

WMA Categories

1. Organic Additives

- Sasobit (Sasol)
- SonneWarmix (Sonneborn)
- Rediset (Akzo Nobel) – *also contains chemical additives*
- Bitutech PER (Engineered Additives)
- LEADCAP (KICT-KUMHO Petrochemical)
- Thiopave (Shell)

WMA Categories

2. Chemical Additives (Surfactants)

- Evotherm (MeadWestvaco)
- Cecabase RT (Arkema Group)
- HyperTherm/QualiTherm (QPR)
- ECOBIT (All States Materials Group)
- Revix (Mathy)

Typical dosage rates of 0.2 to 0.5% of the binder

Many of the WMA Chemical Additives provide anti-stripping additive compounds

WMA Categories

3. Asphalt Foaming Technologies

a. Foaming Additives (Zeolites)

- Advera (PQ Corp.)
- Aspha-min (Eurovia)

Foaming Additive rates are typically 0.25 to 0.30% by weight of mix

WMA Categories

3. Asphalt Foaming Technologies

b. Water Injection Systems

- Accu-Shear (Stansteel)
- AquaBlack (Maxam)
- AquaFoam
- Double Barrel Green (Astec)
- Eco-Foam II (AESCO/MADSEN)
- HGrant Warm Mix System (Herman Grant Co.)
- Meeker Warm Mix
- Terex WMA System
- Ultrafoam GX2 (Gencor)

Most water injection foaming systems add 1 to 2% water by weight of binder

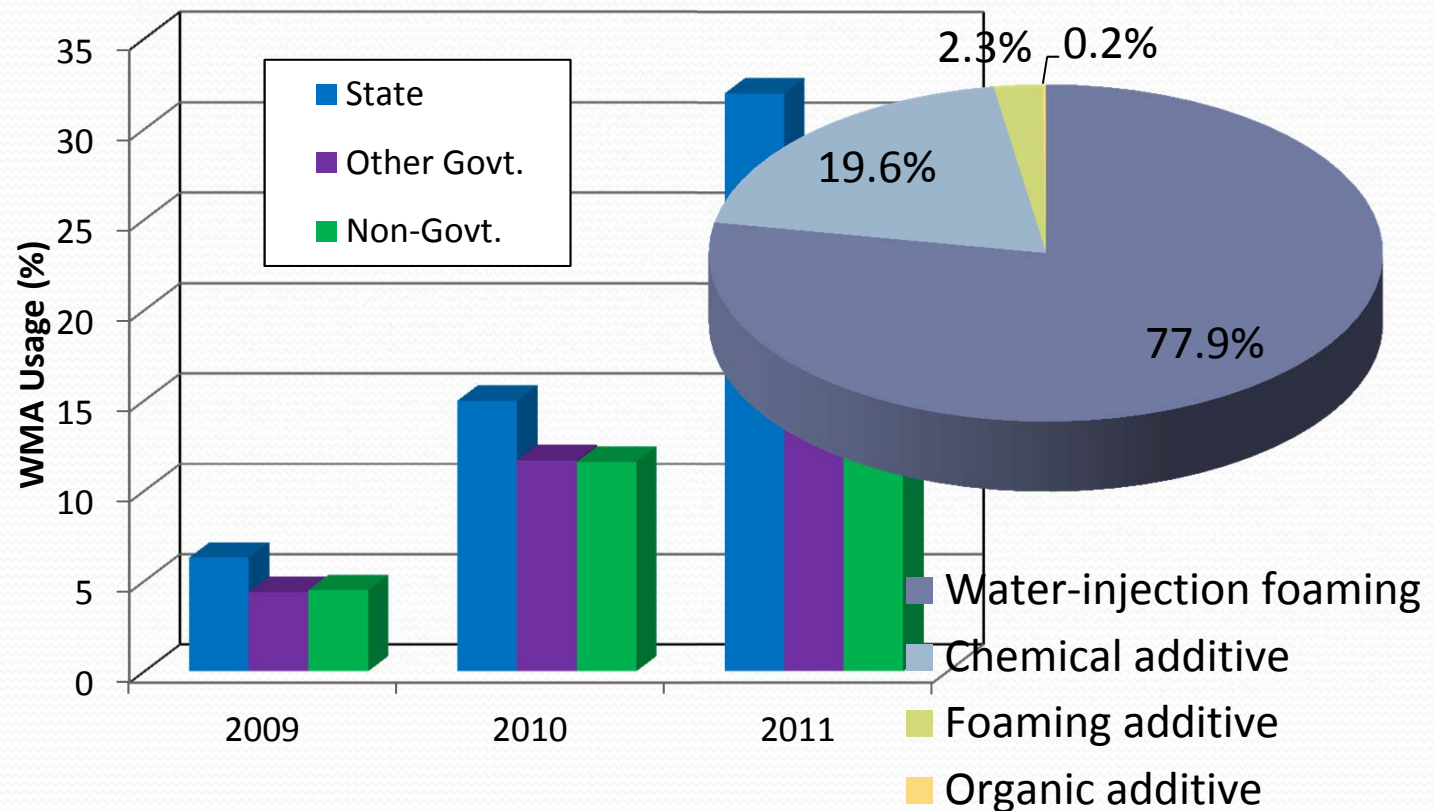
WMA Categories

4. Combinations

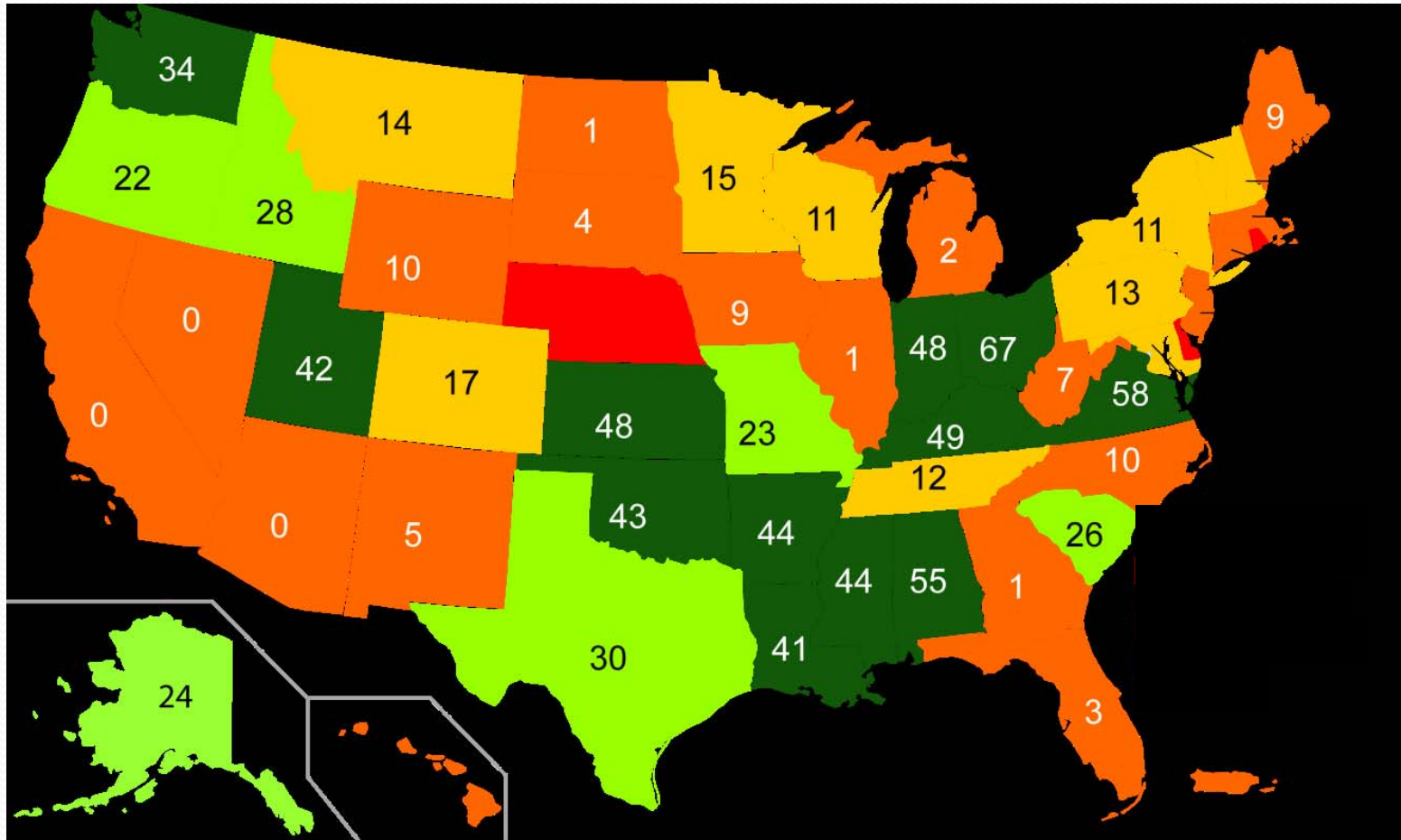
- Rediset (Akzo Nobel)
- Low Emission Asphalt (McConnaughay)
 - Combined foaming and chemical additives
 - Mix production temperatures are typically lower than other WMA processes

What are the most popular
WMA Technologies?

Estimated WMA Production



WMA in 2011 (NAPA)



Advantages of WMA

- Less energy to produce asphalt mixes thus reduced cost
- Better working conditions, less fumes and odors for paving crew and neighbors
- Allow asphalt to be hauled longer distances
- Potential to improve compaction
- Extends paving season

Economics of WMA

- Water-Injection systems cost \$30k to \$80k.
 - Assuming \$50k cost, 150,000 tons/yr., 5-year depreciation, then foamed WMA cost about 7¢/ton.
 - If only 1/3 of production is WMA, then cost is 21¢/ton.
- Popular WMA additives are reported to increase cost by \$2 - \$3/ton of mix.



Energy Savings with WMA

- Fuel savings for WMA is proportional to the temperature reduction.
- Most contractors report burner fuel usage decrease of about 10 to 15%.
- Savings will range from \$0.10 to \$0.80 depending on fuel type and temperature decrease.



Reduced Emissions with WMA



- Especially noticeable at load-out

Better Work Environment



Long Haul Distances

- Haul times with WMA from 1 to 3 hours reported
 - Generally successful in achieving target density
 - Crusting / lumps of mix reported on a few jobs
- Some contractors use normal mix temperatures so the WMA technology is just a compaction aid



Better Workability?

- Most, but not all, contractors report WMA improves workability
- Some also report finish to be better, especially joints.



Example of Long Haul Distance

- 2008 Evotherm Point Arena, CA
- Hauled 4 hours from Santa Rosa, CA to Point Arena
- Mixed at normal hot mix temperatures
- Placed dense-graded and open graded mix

Improved Compactability

- Compaction of asphalt mixtures important for long term performance



Potential WMA Density Benefit

- Some contractors use WMA primarily to improve density.
- Data from NCHRP 9-47A indicated WMA test sections were only 0.17% higher in density than companion HMA sections.
- In a typical PWL specification, even that small improvement can impact the density pay factor and translate to a benefit of up to \$1 per ton.

Cold Weather Paving

- Several WMA projects placed near freezing temperatures reported in trade literature.
- Time for compaction significantly affected by air temperature, wind speed, and layer thickness



Overlaying a Crack Sealed Pavement

- Overlaying pavements with joint/crack sealant causes bump in overlay
- Bumps result in poor ride
- WMA has been used to reduce this problem



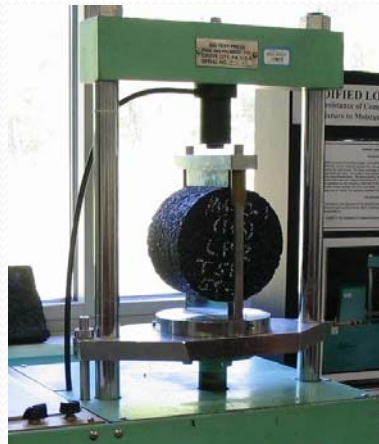
Plant Concerns with use of WMA



- Initial concerns about plant production:
 - Less efficient burner operation (can be adjusted)
 - Incomplete drying of the virgin aggregates (has not been a big problem)
 - Condensation in the baghouse (can be problem, sometimes additional heat applied at baghouse)
 - Increase amperage on motors (not been a problem)

Lab Tests on WMA

- Nearly all WMA produced has used HMA mix designs
- Lower mix temperatures cause less asphalt absorption for some aggregates resulting in a change in volumetric properties.
- Lab tests for rutting and moisture damage potential for WMA commonly yield less favorable results compared to HMA



Combining WMA and RAP

- WMA technologies can improve coating of aggregate during production
- Improved workability
- Lower production temperatures reduce plant aging of binders allowing for increased use of RAP without grade bumping



Combining WMA and RAS

- Typically WMA temperatures closer to HMA temperatures
- Still lots to learn with WMA and RAS
- NCHRP 9-56 study is looking at use of RAS and WMA
- Dr. Richard Willis at NCAT, PI

Summary of Potential Economic Benefits w/ WMA

- Energy savings
- Improved density? → higher pay
- Improved smoothness? → higher pay
- Increased RAP contents?
- Use with RAS???
- Longer hauls/extended paving season
- Maybe eliminate other mix additives?
 - Liquid anti-strip agents
 - Odor scavengers/masking agents
 - Fibers for draindown

Other Resources

- www.warmmixasphalt.com
- NAPA (www.asphaltpavements.org)
 - Warm Mix Asphalt: Best Practices, 3rd Ed. (*QIP-125*)
- ncat.us all NCAT reports can be downloaded
- FHWA-NHI Webinar
 - Special Mixture Design Considerations and Methods for Warm-Mix Asphalt
 - Course Number FHWA-NHI 131137
 - Free, 2 hours

Any Questions???