

## Why Warm Mix Asphalt?



2009 Alaska Paving Summit

Tommy Dumas  
Cradock Construction Company  
November 12-14, 2009 Anchorage, AK

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## Today's Discussion

- ❖ What is WMA?
- ❖ Benefits of WMA
- ❖ Available Technologies
- ❖ National Perspective
- ❖ State DOT's Perspective
- ❖ Local Agency Perspective
- ❖ WMA Contractors Experience

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## What is WMA?

- ❖ Warm Mix Asphalt
  - ❖ Like HMA, but Cooler
    - ❖ Typically 212-275°F
    - ❖ Many WMA Technologies
    - ❖ Similar Stiffness (compactability) at Reduced Temperatures
  - ❖ Produced with minor plant modifications
  - ❖ Placed with Conventional Equipment
  - ❖ Many Benefits over HMA

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## WMA Environmental Benefits

- ❖ Reduces Fuel Consumption Avg. 20% (NAPA)
- ❖ RAP (Reclaimed Asphalt Pavement) Friendly
- ❖ Reduces Odors at Plant and Paving Site
- ❖ Reduces Mat Temperatures at Paving Site
- ❖ Reduces Greenhouse Gas Avg. 10% (NAPA)
- ❖ Reduces Overall Plant Emissions

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## Environmental Aspect is Key



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## Reducing Emissions is Critical

- ❖ "The federal government has officially designated Fairbanks a nonattainment area for PM 2.5."
- ❖ "The clock is ticking... Fairbanks shares the new fine particulate designation with Los Angeles; Tacoma, Wash; Milwaukee; Philadelphia; Cleveland; New York and 40 other cities."

Anchorage Daily News  
November 17, 2009

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## Reduced Emissions

Astec Double Barrel Green

HMA Temp = 320°F      WMA Temp = 270°F




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## Stack Emissions Testing

(Lafarge Report)

Combustion Gas	HMA Production	15% RAP/5% MSM	% Reduction
Oxygen	15.2%	15.8%	-
Carbon Dioxide (CO <sub>2</sub> )	4.6%	4.1%	10.9%
Carbon Monoxide	1.095E-6 lb/ft <sup>3</sup>	9.814E-7 lb/ft <sup>3</sup>	10.4%
Sulphur Dioxide (SO <sub>2</sub> )	1.493E-8 lb/ft <sup>3</sup>	1.707E-8 lb/ft <sup>3</sup>	-14.3%
Nitrogen Oxides (NO <sub>x</sub> )	1.707E-7 lb/ft <sup>3</sup>	1.565E-7 lb/ft <sup>3</sup>	8.3%
Average Mix Temperature	326°F	262°F	24.2%
Average Stack Temperature	228°F	198°F	15.6%

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## Energy Savings

(Lafarge Report)

Mix	Moisture (%)	Mix Temperature (°F)	Asphalt Volume Produced (ton)	MBtu	Mbtu/ton	Energy Savings (%)
HMA- 15% RAP/5% MSM	4.5	336	275	79.1	0.29	24.2
WMA - 15% RAP/5% MSM	4.2	262	507	110.0	0.22	

MBtu = Million British Thermal Units

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## WMA Paving Benefits

- ❖ Equal or Better Compactability
- ❖ Longer Haul Potential
- ❖ Cooler Weather Paving Potential
- ❖ Improves Crack Resistance



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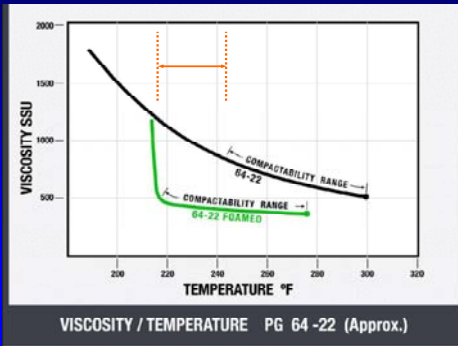
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## Mix Stiffness vs. Temperature



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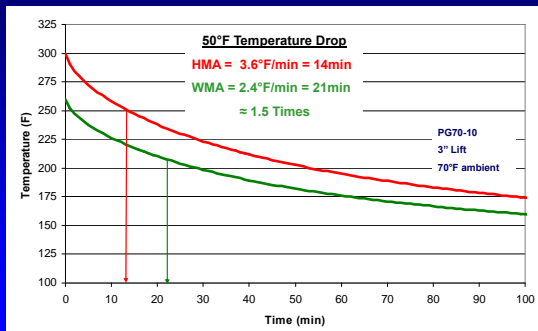
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## Cooling Rate/Compaction Time



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## Combining WMA and RAP

- ❖ FHWA Binder Guidelines for RAP in HMA
  - ❖ 0-15% RAP – No Change in Virgin Binder
  - ❖ 15-25% Bump Virgin Binder Down 1 Grade
  - ❖ > 25% Use Blending Chart to Determine Virgin Binder Grade

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## Available WMA Technologies

- ❖ 3 Categories
  - ❖ Foaming
  - ❖ Chemical
  - ❖ Wax (organics)

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## Available WMA Technologies

- ❖ Foaming (Water Based)
  - ❖ Water-Injection Foaming Process
    - ❖ Astec Double Barrel Green
    - ❖ Gencor Green Machine Ultra Foam GX
    - ❖ Maxam
    - ❖ Terex
    - ❖ Stansteel
    - ❖ WAM
  - ❖ Advera PQ (Synthetic Zeolite)
  - ❖ Others...

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## *Gencor - The Green Machine*



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## *Maxam - Aquablack*



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## *Available WMA Technologies*

- ❖ Wax (Paraffin Wax Based Systems)
  - ❖ Sasobit
  - ❖ ...others
- ❖ Chemical (Surfactant Based Systems)
  - ❖ Evothrm (Several Generations)
  - ❖ Emulsion Technology (ET)
  - ❖ Dispersed Asphalt Technology (DAT)
  - ❖ Revix
  - ❖ Rediset WMX
  - ❖ More every day

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## National Perspective

- ❖ Nationally Driven
- ❖ WMA Technical Working Group (TWG)
  - ❖ NAPA, Agencies, Academia... Promoting
- ❖ TWG Deliverables
  - ❖ WMA Guide Specifications
  - ❖ Testing Framework for Initial Pilot Projects
  - ❖ Support for Various National Cooperative Highway Research Program (NCHRP) research projects to address Specification Challenges

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## National Perspective

- ❖ Specification Challenges
  - ❖ Laboratory Mix Design
    - ❖ Lab Foaming Equipment
    - ❖ Effects on Binder Content
    - ❖ Effect on Binder Properties
  - ❖ Lab Properties vs. Field Properties
    - ❖ Sample Conditioning to Match Performance

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## National Perspective

- ❖ Over 1,000 WMA Projects Nationally to date
- ❖ Within 5 Years 50% AC will be WMA (NAPA 2008)
- ❖ US EPA Green Highways Program (GHP)
- ❖ TARP Money to Agencies for Energy Reductions?
- ❖ 39 States Have Initiated WMA Trial Projects

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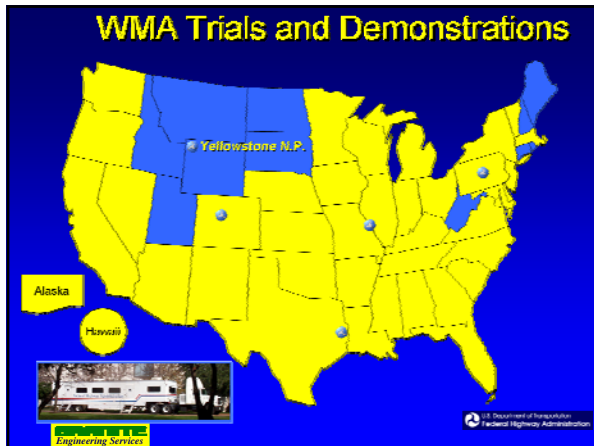
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### *State DOT's Perspective*

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- ❖ 15 States have Permissive Specifications
 

❖ Texas	❖ Maryland
❖ Oklahoma	❖ Wisconsin
❖ Alabama	❖ Michigan
❖ Virginia	❖ South Carolina
❖ Ohio	❖ North Carolina
❖ Delaware	❖ Tennessee
❖ Kentucky	❖ Florida
❖ Louisiana	

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### *State DOT' Quotes \**

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- ❖ **Florida**  
 "Florida is implementing the use of WMA as the choice of the Contractor. This is proceeding well with no issues to date."
- ❖ **Kentucky**  
 "As reported in the Spring 2009, the Kentucky Transportation Cabinet has revised its specifications to permit WMA produced by the water-injection foaming process at the contractors option."
- ❖ **Oklahoma**  
 "WMA mix designs may be used as an alternative to our standard HMA mix designs."

\*NCAT Newsletter Fall 2009  
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## Granite Experience - State DOT

- ❖ WSDOT - SR 520 Sammamish Parkway (5,300 tons/20% RAP)
- ❖ WSDOT - I-5 Northbound 52nd Ave (6,000 tons/20% RAP)
- ❖ WSDOT - SR 101 SR 6 (4,400 tons/20% RAP)
- ❖ WSDOT - SR-12 Mitchell Rd (2,600 tons/20% RAP)
- ❖ WSDOT - SR-546 Guide Meridian (4,000 tons/20% RAP)
- ❖ WSDOT - SR-6 Grays Harbor Project (3,000 tons/20% RAP)
- ❖ WSDOT - SR-532 Starbird Road project (3,000 tons/20% RAP)
- ❖ Caltrans - SR 70 Oroville (1,430 tons/15% RAP)
- ❖ Caltrans - SR 1 Fort Bragg (2,500 tons)
- ❖ Caltrans - SR 101 Scotia (2,600 tons RHMA)
- ❖ Caltrans - Dist. 1 Maintenance (misc. tonnage/15% RAP)
- ❖ UDOT- Wall Ave Region 1 (6,000 tons/15% RAP)

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## Granite Experience - Local Agencies

- ❖ Washington - City of Ocean City (40,000 tons/30% RAP)
- ❖ Nevada - City of Reno (100 tons/30% RAP)
- ❖ Nevada - Washoe County/Corps of Engineers (450 tons/30% RAP)
- ❖ California - City of Coachella (1,000 tons/15% RAP)
- ❖ California - City of Palm Desert (400 tons/15% RAP)
- ❖ California - City Of Indio (1,000 tons/15% RAP)
- ❖ California - County of Kern right-of-way (100 tons/20% RAP)
- ❖ Utah - City of Cottonwood Heights (240 tons/25% RAP)
- ❖ Utah - County of Salt Lake (1,200 tons/25% RAP)
- ❖ Utah - City of Kaysville (250 tons/25% RAP)
- ❖ Utah - City of Ogden (300/25% RAP)
- ❖ Utah - City of South Ogden (55 tons/25% RAP)
- ❖ Utah - Salt Lake City (75 Tons/15% RAP)
- ❖ Utah - City of Vernal (300 tons/25% RAP)
- ❖ Alaska - Ted Stevens International Airport (6,500 tons)
- ❖ Alaska - City of Anchorage (1,200 tons)

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## Granite Experience Private Owners

- ❖ California - Blue Diamond Sacramento - (900 tons 20% RAP)
- ❖ California - Cameron Airpark - (9,200 tons/20% RAP)
- ❖ California - Geyser Industries (3,000 tons/15% RAP)
- ❖ California - Granite Const. Sacramento - (250 tons/20% RAP)
- ❖ California - Granite Const. Bakersfield - (225 tons/10% RAP)
- ❖ California - Granite Const. Bakersfield - (225 tons/20% RAP)
- ❖ California - Granite Const. Indio - (650 tons/15% RAP)
- ❖ California - Granite Const. Indio - (250 tons/30% RAP)
- ❖ Arizona - Granite Const. Tucson - (225 tons/15% RAP)

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*Granite Indio Plant Access Road Warm Mix Asphalt Test Sections, Indio Ca*

Astec Double Barrel Green

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### Rubberized Crack Filler

(No Swelling)

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### City of Indio, CA

1/2 Dense Graded  
 Plant Temp: 270 F. (Astec Double Barrel)  
 Job Temp/Breakdown Rolling: 230 F.  
 Intermediate Rolling 175 F.  
 Final Rolling: 160 F.  
 Average Density: 93% RICE

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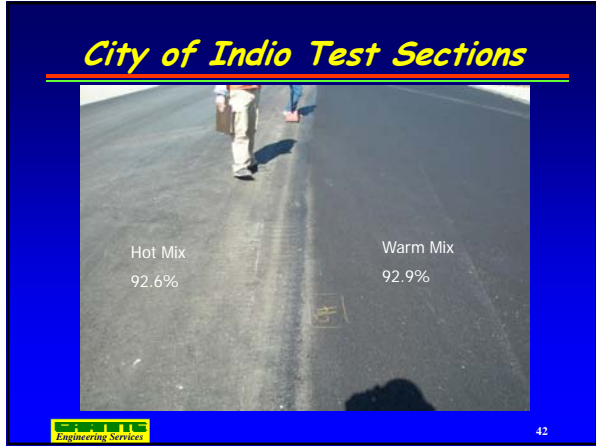
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**Ted Stevens International**



3/4" Dense Graded PG 64-34  
Plant Temp: 235 F. (Evotherm)  
Job Temp: 230 F.  
Avg. Density: 95% RICE

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**Ted Stevens International**



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**Ted Stevens International**



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## ***Ted Stevens International***



**3/4" Dense Graded PG 64-34 PM  
Plant Temp: 285 F. (Evotherm)  
Job Temp: 260 F.  
Avg. Density: 95% RICE**

**Engineering Services**

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## ***Caltrans SR-101 Scotia, CA***



**3/4" RWMA Type G  
Plant Temp: 250 F. (Evotherm)  
Job Temp: 230 F.  
Ambient Temp: 55 F.  
Density: 92-94 RICE**

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## ***Caltrans SR-101 Scotia, CA***



**Engineering Services**

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**Caltrans SR-101 Scotia, CA**



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**Cameron Airpark, Cameron Park, CA**



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**Cameron Airpark, Cameron Park, CA**



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## Caltrans SR-70 Oroville, CA



1400 tons of 1 1/2" OGAC w/ PG 64-18  
3 Month Detour on SR 70  
AADT 18,800, Trucks 18% on 5% Grade

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## Caltrans SR-70 Oroville, CA



Plant Temp: 240 F.  
Job Temp: 230 F. (Evotherm)  
Density: 92-94% RICE

Breakdown Roller Temp 183 – 225 F.  
92% RICE achieved at 160 F.

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## Caltrans SR-70 Oroville, CA



No Smoke!  
No Odor!

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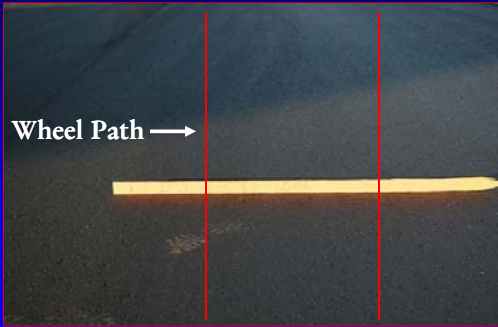
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## Caltrans SR-70 Oroville, CA



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## Recap

- ❖ **WMA is Replacing HMA Nationwide**
  - ❖ Within 4 Years 50% of AC will be WMA
  - ❖ Some States >50% WMA
- ❖ **States DOT's are Implementing WMA**
  - ❖ 39 States Running Trial and Demonstration Projects
  - ❖ 15 States Have Permissive (Contractor option) Specifications
- ❖ **Reduces Greenhouse Gas Emissions**
  - ❖ 10% on Average (NAPA 2009)

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## RECAP

- ❖ **Reduces Energy Consumption**
  - ❖ 20% on Average (NAPA 2009)
- ❖ **Improves Paving Efficiency**
  - ❖ Allows for Longer Hauls
  - ❖ Cooler Weather Paving
- ❖ **Allows for Higher RAP Contents**
  - ❖ Reduces Virgin Binder Stiffness

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## RECAP

- ❖ Improves Performance
  - ❖ Equal or Better Compaction
  - ❖ Improves Long Term Durability (crack resistance)
- ❖ Will Ultimately Reduce Cost to Owner
  - ❖ Contractor Option
    - ❖ WMA
    - ❖ RAP

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Thank You



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