Warm-Mix Asphalt using Sasobit: The Petersburg-Mitkof Hwy Experience

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Asphalt Pavement Summit
Anchorage, 18-Nov-09

What is Warm Mix Asphalt?

- Hot Mix Asphalt 280 - 325°F
- Cold Mix Asphalt ~ 60°F
- Warm Mix Asphalt ~200°-270°F

Technologies Marketed in U.S.

WMA Technology	Process Type
Advera	Additive/Foaming
Aspha-min	Additive/Foaming
Cecabase RT[1]	Chemical Additive
Double Barrel® Green	Foaming
Evotherm™	Chemical Additive
Gencor[1]	Foaming
(LEA) Low Energy Asphalt	Foaming (moisture in fine aggregate)
Rediset™ WMX	Chemical Additive
REVIX™	Chemical Additive
Sasobit	Organic Additive
StanSteel[1]	Foaming
Synthetic Zeolite	Foaming
Terex[1]	Foaming
WAM-Foam	Foaming

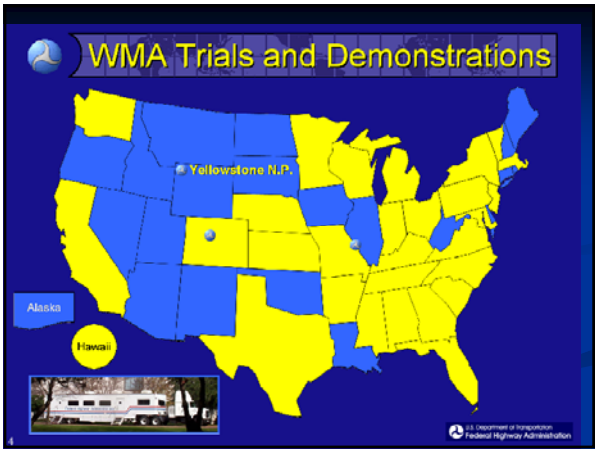
[1]Recent Technology

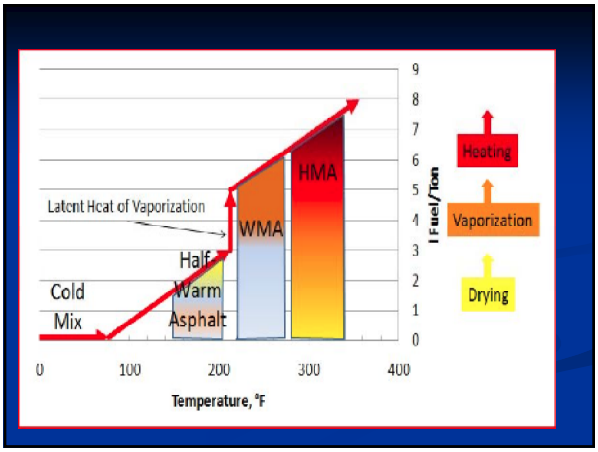
Really 3 General Types of WMA

- Wax
- Chemical Additive
- Foaming

WMA Benefits

- Paving Benefits
  - Compaction aid
  - Cool-weather paving
  - Longer haul distances
  - Use of higher percentages of RAP
  - Less restriction, enabling more production in in non-attainment areas
  - Extend the paving season
- Reduced Fuel Usage
- Reduced Emissions
- Improved Working Conditions for Paving Crew

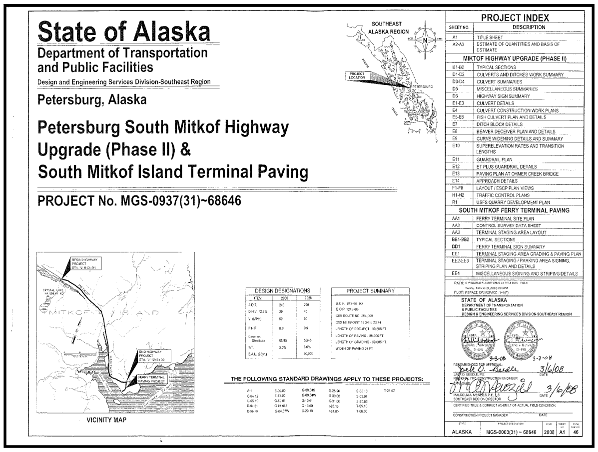




3 WMA Projects in Alaska

- Petersburg South Mitkof Highway Project (Sasobit Wax)
- Alaska Highway, Tok, Foaming Project
- EVOTHERM, Anchorage International Airport

Alaskan WMA Demonstration South Mitkof Highway Upgrade Phase II September - October, 08



State of Alaska
Department of Transportation and Public Facilities
Design and Engineering Services Division-Southeast Region
Petersburg, Alaska

Petersburg South Mitkof Highway Upgrade (Phase II) & South Mitkof Island Terminal Paving

PROJECT No. MGS-0937(31)~68646

PROJECT INDEX

VICINITY MAP

THE FOLLOWING STANDARD DRAWINGS APPLY TO THESE PROJECTS:

Project Information

- CDS Milepoint 16.24 to 23.74
- Paving length = 7.5 miles (39,606 ft)
- Two-lane 24 ft rural highway, unpaved
- AADT = 250, 3% trucks, EAL_{2026} = 50k
- 3-inch Single Lift
- ~ 25,000 Tons WMA
- Contractor: SECON
- Paving: Sep.'08

MD Developed using Standard 50 blow Marshall, Compacted @ Conventional 300ºF w/o Sasobit Additive,

Checked w/Additive and Reduced Comp. Temperature (~ 250ºF)

300º F w/o Wax	260º w/ Wax
AC Content = 5.0%	AC Content = 5.0%
2.5 % Voids (< than desired)	3.5 % Voids (ok)
VMA 13.9 %	VMA 14.8 %
VFA 82 % (> than desired)	VFA 76 % (ok)

Sasobit Additive

- Sasobit (High MP Wax)
- Added at Refinery
- Rate of 1.5% by Wt. of AC (~ 30 lbs/ton)
- PG 58-28+ Specified
- ER of 50% min. (AASHTO T-301 25ºC)

Binder Properties with and w/o Additive

- Acceptance Samples w/o Additive, Before Construction
- Construction Samples w/wax for information

Test Method	Acceptance	Information	Mean
T-313 BBR	w/o wax	w/wax	
Stiffness	All 6 ok	All 6 ok	
m-value	All 6 ok	Non ok	.281
T- 316 BV			
Brkfld. Vis.	All 6 ok	All 6 ok	
T-315 DSR			
G*/Sin δ O, RTFO, PAV	All 6 ok	5 ok, 1 dnp	
ER	All 6 ok	All 6 ok	PG 70-(24,26)

Final PG Grade with wax

6 samples tested

PG 70-24 1 result

PG 70-25 4 results

PG 70-26 1 result

Plant

- Drum Dryer Plant: 350 TPH

- Aggregate source: 1 mile from plant

PG 58-28+ Asphalt Binder

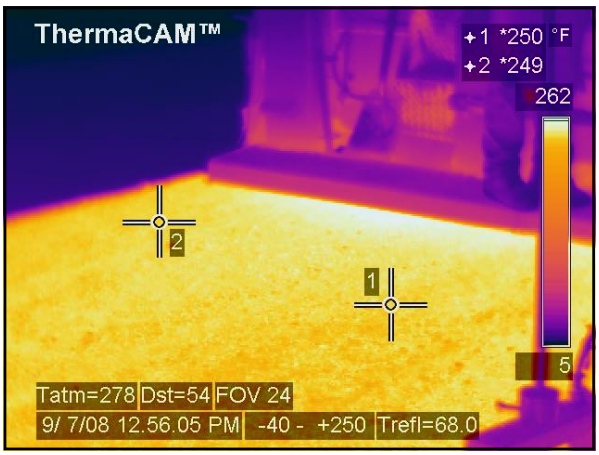
US Oil & Refining, Tacoma, WA

Paver & Pick Up Machine

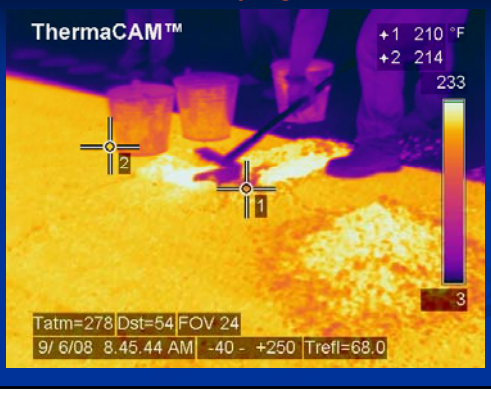

Beginning of Construction
Typical Production Temperature


252.0 F

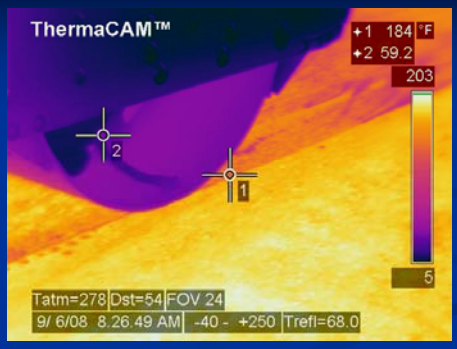

Infrared Thermal Cam


ThermaCAM™
1 *250 °F
2 *249
262
2
1
5
Tatm=278 Dst=54 FOV 24
9/ 7/08 12.56.05 PM -40 - +250 Trefl=68.0

Sampling



Compaction



Compaction

Post-Construction Smoothness - LISA

Ride Measurements
PI Simulation LWP

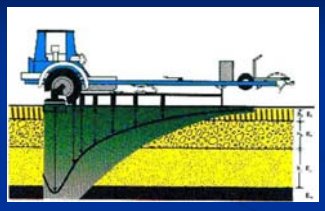
Southbound XL Lake to Ferry Terminal	Northbound Ferry Terminal to XL Lake
Average 3.8 inches/mile (9/14/08)	Average 3.3 inches/mile (9/14/08)
Average 5.2 inches/mile (8/30/09)	Average 4.7 inches/mile (8/29/09)

Rut Measurement Averages
LWP in each Lane

Southbound XL Lake to Ferry Terminal	Northbound Ferry Terminal to XL Lake
.006 inches (9/26/2008)	.001 inches (9/26/2008)
.010 inches (7/17/2009)	.015 inches (7/17/2009)

One year later no significant rutting

FWD Evaluation



WMA Modulus = E = 515 ksi

Laboratory Tests
The Asphalt Institute

- Type II-B, 19 mm NMAS
- PG 58-28+, Binder = 5% , VTM = 2.5%
- 10 boxes; re-heat, compact

Tests:
- Tensile Strength Ratio: 1 freeze-thaw cycle
- Asphalt Pavement Analyzer: 45°C
- Hamburg Wheel Tracker: 45°C
- Dynamic Modulus: 4°C, 20°C, 35°C

TSR – Indirect Tensile Strength Test

Effect of Moisture on Asphalt Concrete Paving Mixtures

AASHTO T283/ASTM D4867

Compaction Method:	SGC 150mm
Freeze/Thaw	x

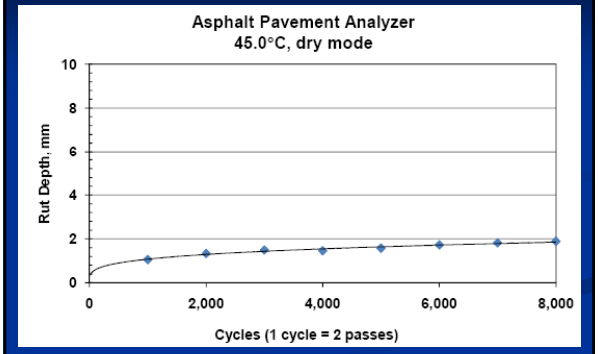
Air Voids, % (100(G-F)/G)	H	7.2	6.5	6.5	6.8	7.1	7.1

Dry Strength, kPa 2P/(tDπ)	S1	507.4		542.8		642.3	
Wet Strength, kPa 2P'/(t'Dπ)	S2		533.3		632.2		583.8
Visual Moisture Damade (0 to 5-stripped)		na	na	na	na	na	na
Average Dry Strength, kPa	$S1_{avg}$	564.2					
Average Wet Strength, kPa	$S2_{avg}$	583.1					
TSR 100($S2_{avg}$/$S1_{avg}$)		103.4					

Asphalt Pavement Analyzer

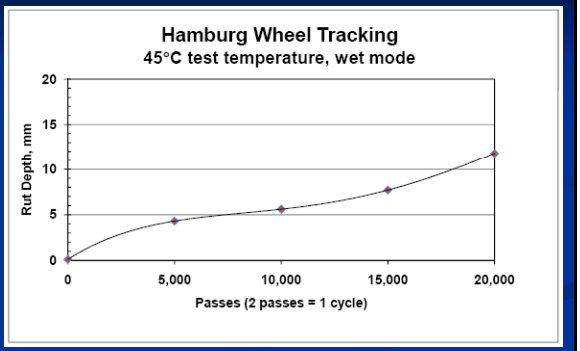
AUTC-UAF

TAI: Air voids = 6.9%, 113°F



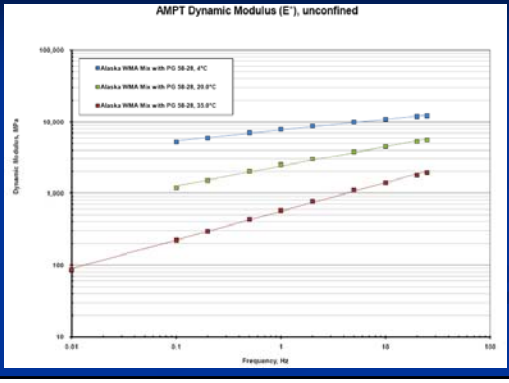
Hamburg Wheel Tracking

TAI: Air voids = 6.8%, 113°F



Simple Performance Tester
(Asphalt Mixture Performance Tester)

TAI: Simple Performance Test (39, 68, 95°F)



Dynamic Modulus Comparisons

Frequency = 10 Hz

TAI, 1.5% Sasobit Mix, Air Voids = 6.7%

Dyn. Modulus, ksi		
4 C	20 C	35 C
1,600	650	200

Frequency = 10 Hz

AUTC, Control Mix, Air Voids = 4.6%

Dyn. Modulus, ksi		
4 C	21 C	38 C
1,900	800	220

Bid Data for WMA Project

- Mix Price $60/ton 22,500 tons total (typical price for 401(1))
- AC Price $750/ton 1145 tons total
- (w/o Wax Additive $720/ton)

Lessons Learned

- Field density achieved in all cases
- Saved ≈ 20-30 % in fuel at the plant (1 gal/ton)
- Temperature at plant hard to regulate
- Mix handled similarly as HMA
- Workers noted no handling difficulties
- No smoke
- Additive didn't seem to affect mix design
- Sasobit does stiffen binder

PG Grading Implications

- Original binder grade met PG 58-28 (PMA)
- Elastic Recovery (AASHTO T-301) $\geq$50%

- After 1.5% Sasol Wax addition
- PG Binder changed to PG 70-25
- Degree of stiffening is crude dependant

- Sasol wax does stiffen the binder
- Elastic recovery was unaffected

What's Next

- More Field Monitoring

- Annual Inspections for the next 2 years

Why Warm Mix?

- Warm Mix can address a variety of needs
  - Improved compaction
  - Fuel Savings
  - Environmental
  - Working conditions
- Significant research already completed
- Future looks warm!

For What We Know Now:

WMA = HMA