

# Warm Mix Asphalt Technologies

## Field Trial/ Open House

Presented by



Cambridge, Ohio

September 12, 2006

Larry L. Michael  
Asphalt Consultant  
Hagerstown, MD

301-745-3334



## Overview

- What is Sasobit?
- How does Sasobit work?
- US Projects
- Summary



## Sasobit®



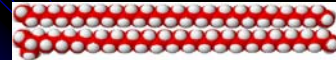
- Product of
  - Sasol Wax GmbH (Germany)
- Fischer-Tropsch paraffin wax
  - Fine crystalline long chain aliphatic hydrocarbon
  - Produced from coal/natural gas gasification
- Available in
  - Flakes or powdered form
  - 20 and 600 kg bags

USA Department of Transportation  
Federal Highway Administration



## Sasobit®

- A high molecular mass synthetic aliphatic hydrocarbon
- Molecule length between  $C_{40}$  and  $C_{120}$ . It is produced by Fischer-Tropsch synthesis from coal or natural gas.
- High melting - congealing point min. 99°C, melting range 70-115°C
- Hard - needle penetration < 1 dmm at 25°C
- Low viscosity - 12 mPas at 135°C

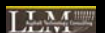
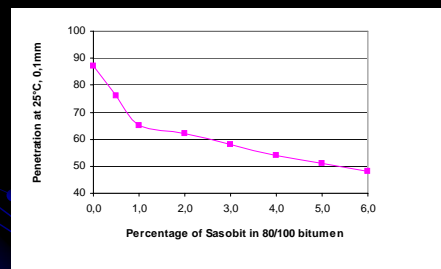


## Solubility of Sasobit® in bitumen

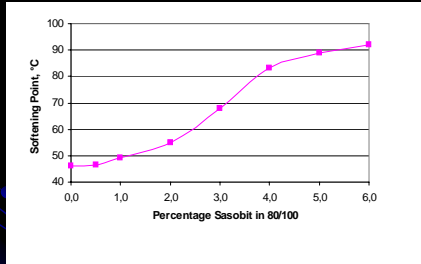
- Sasobit® is completely and homogeneously soluble in bitumen above 115°C
  - decreased binder viscosity
- No high shear mixers required
- No separation, even after solidification and re-heating of the modified bitumen
  - increased binder stiffness



## Impact of Sasobit® on needle penetration



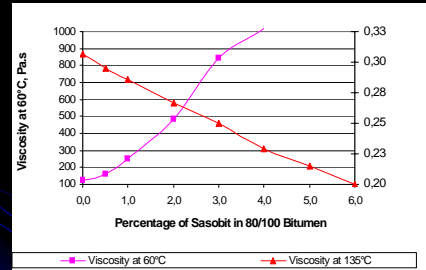
## Influence of Sasobit® on softening point



**SASOBIT**

U.M. UNIVERSITY

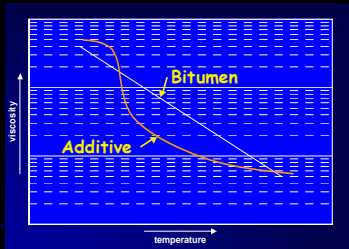
## Influence of Sasobit® on viscosity



**SASOBIT**

U.M. UNIVERSITY

## How organic additives work...



U.M. UNIVERSITY

## NCAT Evaluation

- Improved compact ability to 190 F
- Did not affect resilient modulus
- Did not increase rutting potential (APA)
- Cure time to open to traffic is not an issue
- Moisture damage with lower temperature may be an issue
- Anti-aging Properties

U.M. UNIVERSITY

## Warm Mix Technology

- Reduce Mixing and Compaction Temperature
- Reduce Fumes
- Reduce Fuel Costs
- Viscosity Reduction
- Improve Workability
- Improve Compaction/Density
- Extend Paving Window
- Cold-Weather Paving
- Improve Quality

U.M. UNIVERSITY

## Reduce Fuel Costs



European and US Studies

Indicate up to 30% Reduction in Fuel Costs

However...

"That Depends"

U.M. UNIVERSITY

## Reduce Emissions



European and US Studies

Indicate up to 30% Reduction in Emissions

However

"That Depends"



## Reduce Mixing and Compaction Temperature



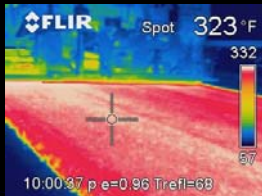
I95/I495  
Washington Beltway  
PG 76-22, 19mm SMA  
300°F to 250°F



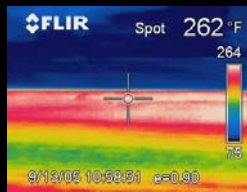
County Road  
PG 64-16, 19mm DG  
300°F to 240°F



## Reduce Mixing and Compaction Temperature



9.5MM Rap Mix  
With Sasobit  
PG 64-22



9.5mm Rap Mix  
PG 64-22



## Reduce Fumes



SASOBIT

CONTROL



## Reduce Fumes



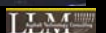
Control  
300° F.



Sasobit  
275 to 220° F.



## Reduce Fumes



## Viscosity Reduction

Improve Workability



19mm High Rap Base  
PG 64-22



## Viscosity Reduction

Improve Workability



9.5mm High Rap  
PG 64-22  
275°F with WMA



## Viscosity Reduction

Improve Compaction/Density

ICC Draft Report



Stiffness of Conventional Mix and Sasobit were statistically the same with Sasobit being placed 50°F cooler



## Viscosity Reduction

Improve Compaction/Density



## Viscosity Reduction

Cold-Weather Paving

Location – Parking Lot

Drum Plant

Mix--25mm Dense Graded - 25% RAP

Binder- PG 64-22

Depth – 50MM

Weather- 37 ° F Windy

Sasobit– 1.5% Added to Binder

Control Section – Target temperature 300° F.

Sasobit Section– Target temperature 250°F



## Viscosity Reduction

Cold-Weather Paving

25mm Dense Graded 25% RAP



## Viscosity Reduction

Reduce Emissions/ Reduce Fumes

### SAM

Stress Absorbing Membrane

1.0 and 1.5 % Sasobit  
added to 20% asphalt rubber  
blends

### SAMI

Stress Absorbing Membrane  
Interlayer

Reduced Temperature by  
**75° F.**



## Viscosity Reduction



## Viscosity Reduction Reduced Temperature

Missouri Department of Transportation  
and  
Pace Construction



**Warm Mix Asphalt Demonstration**

May 17-26, 2006



## Three Technologies...


Aspha-Min®

**EVOTHERM**  
WARM MIX ASPHALT TECHNOLOGY


**SASOBIT**

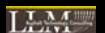


## Goals:

Reduce or  eliminate bumps



 Excessive joint sealing material





## Sasobit® Added to mix:



Hi-Tech Asphalt Solutions®  
feeder



## Mix Design and Notes

Binder Content, %	5.4
Maximum Specific Gravity	2.451
Gradation: Sieve size, mm	Percent Passing
12.5 mm	97.5
9.5 mm	87.1
4.75 mm	58.1
2.36 mm	38.5
1.18 mm	25.3
.60 mm	16.1
.30 mm	10.0
.150 mm	6.5
.075 mm	5.2

RAP - 10%  
Binder - PG 70-22 (unmodified)  
Additive - ARR MAZ .25% by weight of AC  
Sasobit® - 1.5% by weight of AC



Behind paver



Completed Surface



	Temperature (°F)	Air Voids	VMA	% AC	Sample Location	Tested By:
TARGET		4.0	14.0	5.4		
Control 5/17/06		3.7	14.2	5.3	Field	State
		4.4	14.6	5.1	Field	Contractor
		4.2	14.6	5.1	Field	Contractor
Sasobit 5/18/06	280°F (Molding Temp. 275°F)	3.3	15.1	5.7	Plant/Truck	Contractor
		3.9	15.7	5.6	Plant/Truck	Contractor
		3.3	15.0	5.7	Plant/Truck	State
	240°F (Molding Temp. 230°F)	4.3	15.2	5.4	Field	Contractor
		3.4	15.0	5.6	Plant/Truck	Contractor
		3.1	14.4	5.5	Field	Contractor
Sasobit 5/19/06	240°F (Molding Temp. 240°F)	3.7	15.2	5.5	Plant/Truck	Contractor
		4.1	15.1	5.4	Field	Contractor
	240°F (Molding Temp. 240°F)	3.1	14.4	5.5	Field	State
		3.5	14.8	5.5	Field (Behind Paver)	Contractor
Moisture Content of Mix at 240F						
	Normal			0.05%		
	With Sasobit			0.06%		



## Summary of Density Results

	Temperature (°F)	Average Thickness	92-96% Density 1	92%-96% Density 2	>90% Joint Density
Control 5/17/06		2.5		95.7	
		2.25			93.8
		2.75	93.4		
		2.25		93.8	
		2.0			99.8 <sup>(1)</sup>
		3.0	94.0		
Sasobit 5/18/06	280°F Production Temperature	2.25	92.2		
		2.25			90.7
Sasobit 5/19/06	240°F Production Temperature	2.25	94.1		
		240°F Production Temperature	1.5	91.6	
		2.25/2.0	94.6		
					91.3



(1) – recut core results 94.0% and 93.6%

# Wisconsin

## Warm Mix Asphalt Open House



June 19-20, 2006  
Oak Creek, Wisconsin



# Mix Design

Sieve Size	Percent Passing
19.0mm	100.0
12.5mm	96.5
9.5mm	88.5
4.75mm	68.2
2.36mm	49.3
1.18mm	33.9
0.60mm	21.3
0.30mm	11.3
0.15mm	6.6
0.075mm	5.2
Gsb	2.684
Binder Content	5.3



# Quality Control Test Results

Sieve size	Percent Passing					
	Sasobit®			Control		
Lot	8-1	8-2	8-3	8-4	8-5	
19.0mm	100	100	100	100	100	
12.5mm	97.3	96.6	98.7	95.7	97.0	
4.75mm	72.1	69.3	68.5	66.5	68.6	
2.36mm	52.1	50.5	49.7	48.0	49.6	
0.60mm	24.4	24.2	23.3	22.5	23.8	
0.30mm	12.6	12.5	12.1	11.7	12.4	
0.75mm	5.5	5.5	5.7	5.3	5.5	
Pb	5.2	5.19	5.17	5.17	5.16	
GMM	2.526	2.517	2.518	2.521	2.533	
Gmb	2.437	2.427	2.434	2.441	2.428	
VA	3.5	3.6	3.3	3.2	4.1	
VMA	13.9	14.3	14.0	13.8	14.2	
VFB	74.8	74.8	76.4	76.8	71.1	

**Notes:**

Pb- Percent Binder  
Gmm- Maximum Specific Gravity  
Gmb- Bulb Spec Gravity  
VTM-Voids Total Mix  
VMA- Void Mineral Aggregate  
Voids Filled with Asphalt



# Why Not Warm Mix?

- Costs
- Testing
- Long-Term Performance
- DOT Acceptance
- AASHTO Provisional Standard



## Long Term Performance

- ✦ **European Experience**  
10 Millions Tons, no Failures
- ✦ **Improved Density**
- ✦ **Reduce Permeability**
- ✦ **Improve Quality**

**SASOBI**



## DOT/ Local Government Acceptance

**That Depends**

**Need**

**Environmental Regulations**

**Cold-weather Paving**

**Workability**

**Partnership With Industry**

**Why Not?**

**We are Here To Help !!!**



# Questions?

Larry L. Michael  
Asphalt Consultant  
Hagerstown, MD  
301-745-3334

