

Akzo Nobel Rediset™ Warm Mix Solutions

*‘Warm Mix Additive that
also function as an antistripping Additive’*

Patents pending



AKZO NOBEL

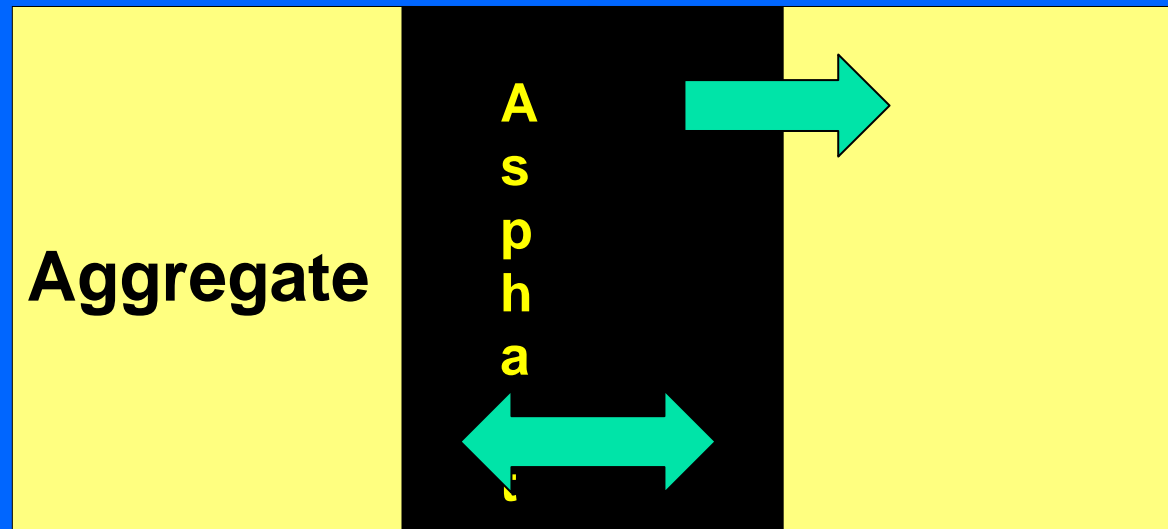
Akzo Nobel Rediset™ wmx Solutions

Main Focus

- Reducing mix and paving temperatures
 - To improve mix workability
- Addressing moisture damage in warm-mix
 - Inefficient aggregate drying at lower temp.,
 - Low temperatures being pushed to extreme limits
- Ensuring Cost effective solution



Mechanism of Moisture Damage Adhesion and Cohesion



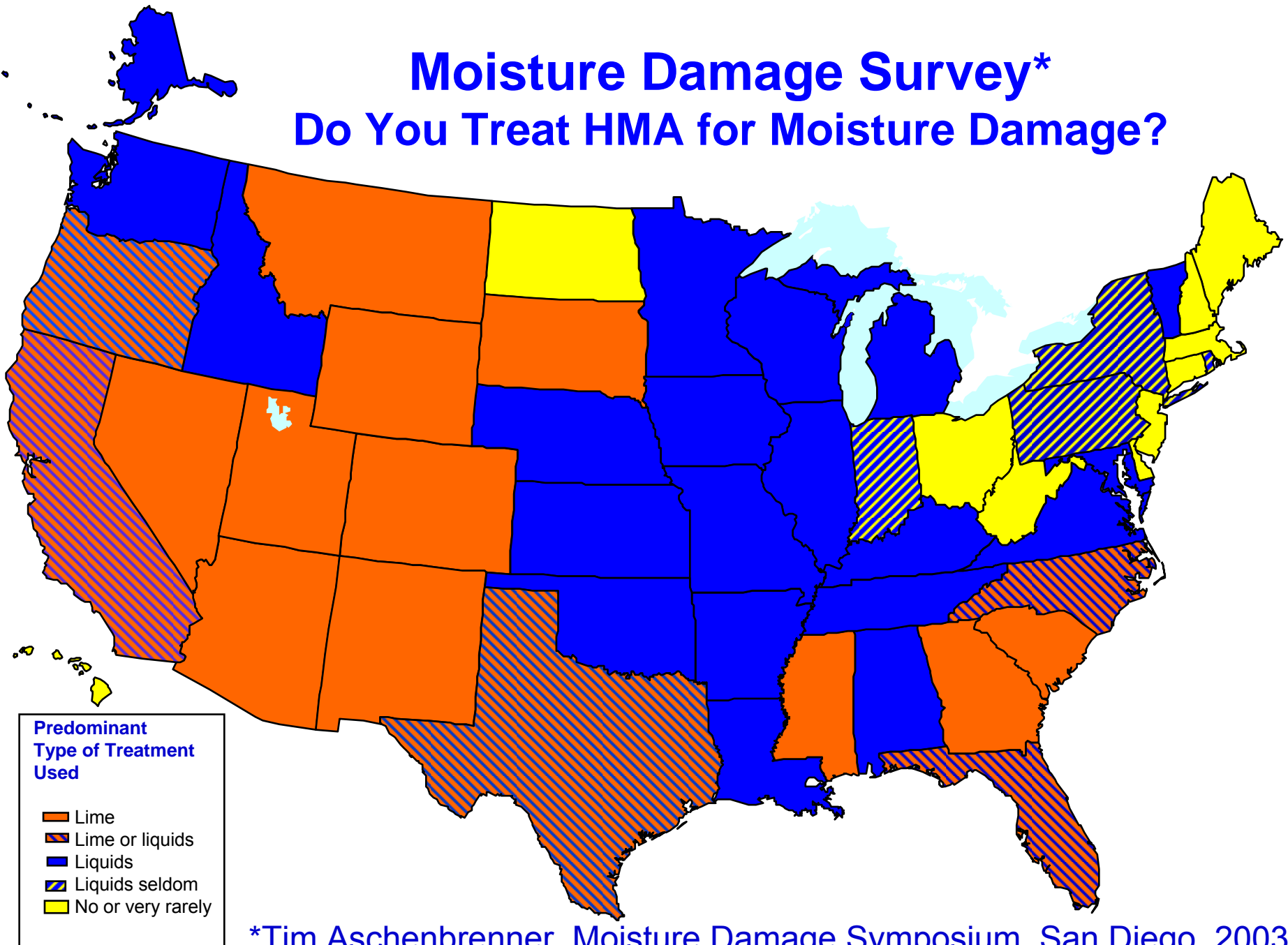
Moisture Damage

- Adhesion failure
 - Water has a higher affinity compared to asphalt
 - Asphalt cannot bond to aggregate with a wet surface
- Cohesion failure
 - Inclusion of water within asphalt will weaken it's cohesive strength



Moisture Damage Survey*

Do You Treat HMA for Moisture Damage?



Predominant Type of Treatment Used

- Lime
- Lime or liquids
- Liquids
- Liquids seldom
- No or very rarely

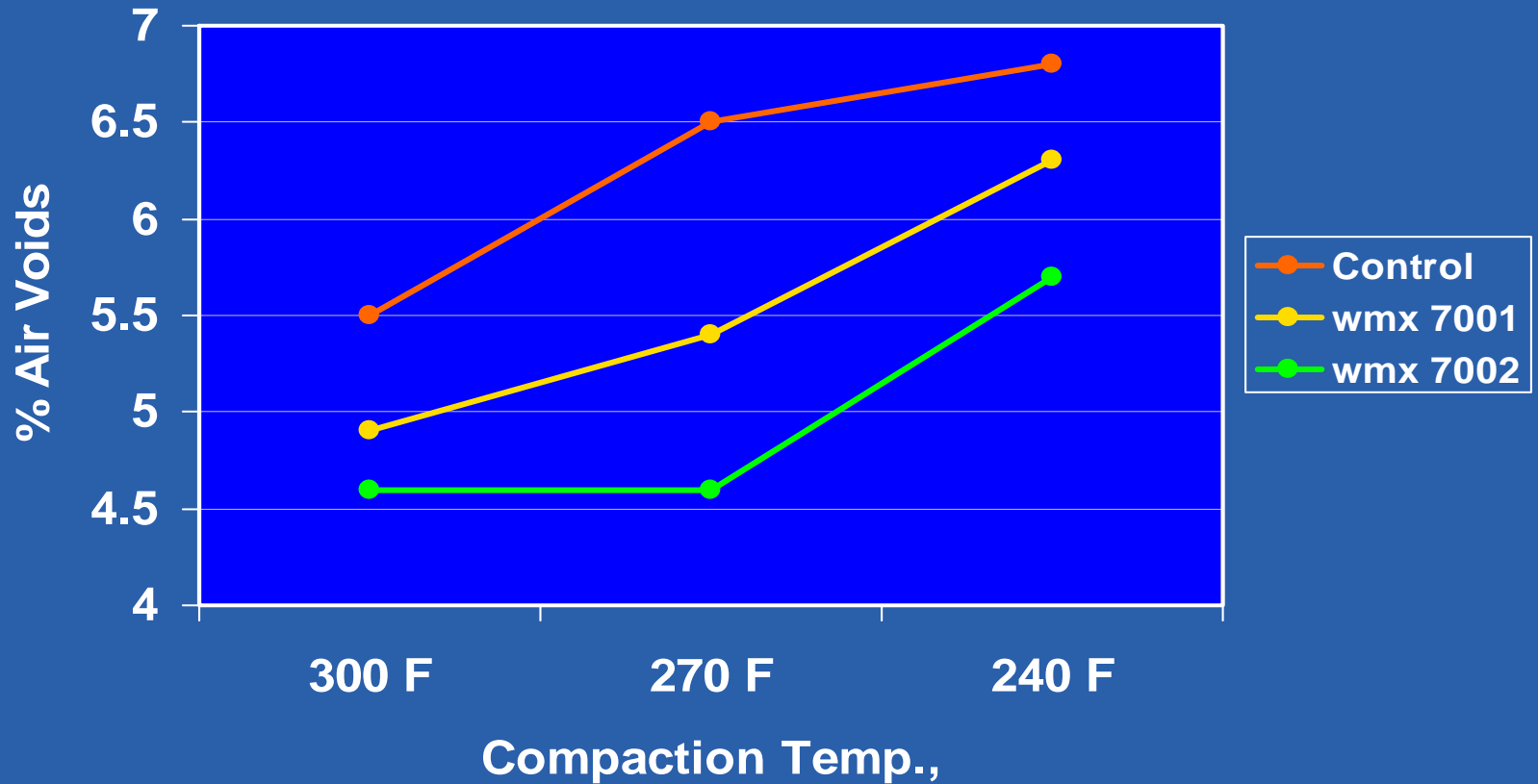
*Tim Aschenbrenner, Moisture Damage Symposium, San Diego, 2003

Akzo Nobel Rediset™ wmx Solutions

- Testing at NCAT
 - Densification, Moisture Damage
- Texas Hamburg Wheel Tracking Tests
- PG test results with warm-mix additive
- Function of Rediset™ wmx additives
- Field Trial, Chico, CA



Compaction Test Results - NCAT Vibratory Compactor



PG 76-22 Asphalt
Superpave coarse graded granite mix (12.5 mm max)



AKZO NOBEL

Moisture Sensitivity Test Results - NCAT

Tensile Strength Ratio*

Warm-Mix Additive	Conditioned Tensile Strength psi	Unconditioned Tensile Strength psi	Tensile Strength Ratio
WMX 7001	74.7	79.4	0.94
WMX 7002	74.2	83.7	0.89

* Compacted at 270°F

PG 76-22 Asphalt

Superpave coarse graded granite mix

(12.5 mm max)



AKZO NOBEL

Moisture Sensitivity Test Results - NCAT

Hamburg Wheel Tracking Test*

Mix Type	Air Voids , %	Comp. Temp., F	Strip. Infl. Point, cycles	Total Rutting @ 10,000 cycles, mm
WMX 7001 #1	7.2	270	> 10,000	5.15
WMX 7001 #2	7.0	270	> 10,000	6.62
WMX 7002 #1	7.0	270	> 10,000	4.73
WMX 7002 #2	7.0	270	> 10,000	3.77

* Compacted at 270°F

PG 76-22 Asphalt

Superpave coarse graded granite mix
(12.5 mm max)



AKZO NOBEL

Texas Hamburg Wheel Tracking Test

APAC 76-22 Asphalt

Material ID	Comp. Temp.	Additive %	% Air Voids	Cycles to failure	Deform, mm
Control + LAS	300 F	0.75	0.71	>20,000	<12.5
WMX 7001-A	250 F	2.0	6.8	29,900	12.32
WMX 7002-B	250 F	2.0	6.8	29,975	12.40

Type D Surface, Design #7-MMD-05
Hamburg Test Temp 50 C
A= Added to binder
B= Added to aggregate mix



AKZO NOBEL

Hamburg Wheel Tracking Test

Lime comparison – PaveTex

Note: Lime % of mix vs Rediset™ WMX % binder

Mix Composition: BR 710 Ty D
5.2% Alon Big Springs PG 70-28

Material ID	Mix Type	Additive, %	Test Temp, C ⁰	Cycles To Failure	Deform, mm
Control	D	0.0	50	18,177	12.50
Hydrated Lime	D	2.0	50	20,000	3.50
WMX 7019	D	2.0	50	20,000	2.93
				25,000	3.19
				30,000	3.41
WMX 7020	D	2.0	50	20,000	3.50
				25,000	3.50
				30,000	3.66

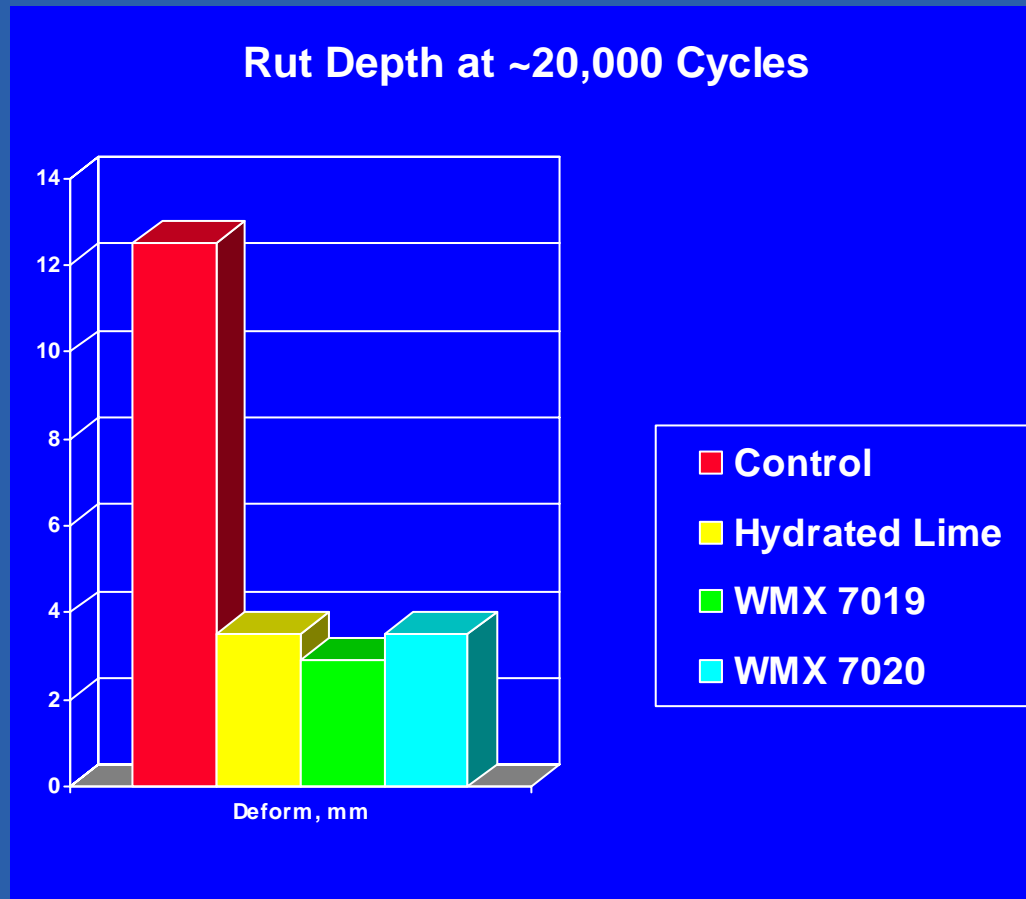


AKZO NOBEL

Hamburg Wheel Tracking Test

Lime comparison – PaveTex

Note: Lime at 2% mix vs Rediset™ at 2% binder



AKZO NOBEL

PG Testing Results

Test	PG 76-22	PG 76-22 + 2% WMX 7001	PG 76-22 + 2% WMX 7002
G*/Sin d (kPa) @ 76° C	1.17	1.05	1.03
RTFOT G*/Sin d (kPa) @ 76°C	2.49	2.27	2.25
BBR Creep Stiffness, S, @ -12° C	185	144	140
BBR, Slope m-Value @ -12° C	0.316	0.342	0.344
Original Binder, Phase Angle @ 76° C, Degrees	73.8	70.20	72.0



Rediset™ wmx

- Solid Additive – Pastilles
- Added to the asphalt
- Also can be added to the mix at the hot-mix plant



Rediset™ wmx Function

Improve mix workability

- Reduce viscosity of asphalt and hot-mix
- Reduce surface tension of asphalt
- Easier to coat the aggregate and easier to compact
 - Reduce mix and compaction temperatures



AKZO NOBEL

Rediset™ wmx - Function

Increase resistance to moisture damage

- Rediset™ modified asphalt has higher affinity to the aggregate compared to water
- Displaces water from the aggregate surface and form bonds
- Acts as a bridge holding asphalt and aggregate together
- Bonds resistant to the action of water
- Additive increases cohesive strength of asphalt



Warm-Mix Trial

Chico, CA - November 13, 2007

- Kent's Oil
Sacramento, CA
- Baldwin Contracting
Company, Inc
Chico, CA
- Knife River Companies
- Akzo Nobel Surface
Chemistry LLC



AKZO NOBEL

Warm Mix Trial at Chico, CA

300°F Control Mix	240°F Warm Mix	270°F Warm Mix
64-10 Asphalt	64-10 Asphalt + 2% Rediset™ WMX	64-10 Asphalt + 2% Rediset™ WMX

1. Pug mill Amps
2. Field Densities
3. Qualitative assessment of fumes



Kent's Oil Blending into the asphalt tank



AKZO NOBEL

Reviewing plans for the trial



AKZO NOBEL

Tack Coat



AKZO NOBEL

Control Room



AKZO NOBEL

Warm Mix



AKZO NOBEL

Windrow paving



AKZO NOBEL

Paving 240°F Mix (Average Temp.)



AKZO NOBEL

Compaction



AKZO NOBEL

After first pass of roller



AKZO NOBEL

Control 300°F Mix



AKZO NOBEL

240° F and 300° F Mixes



AKZO NOBEL

Pug mill Amperage

Average Mix Temp.,	240°F	270°F	300°F (Control)
Pug mill Amps	135-140	120-125	120-125



Density measurements



AKZO NOBEL

Warm Mix Trial Chico, California

% Relative Compaction

CT 308A Method

Type of Mix	Core Density (bulk)	%RC Rice
240°F Mix (Ave.) Rediset™ WMX 2%	2.319	91.9%
270°F Mix (Ave.) Rediset™ WMX 2%	2.329	92.3%
300°F Mix (Ave.) Control	2.275	90.2%

PG 64-10 Asphalt Mix



AKZO NOBEL

Warm Mix Trial Chico, California

% Relative Compaction

ASTM D2726 Method

Type of Mix	Core Density (bulk)	%RC Rice
240°F Mix (Ave.) Rediset™ WMX 2%	2.327	92.2%
270°F Mix (Ave.) Rediset™ WMX 2%	2.339	92.7%
300°F Mix (Ave.) Control	2.286	90.6%

PG 64-10 Asphalt Mix



AKZO NOBEL

All Three Mixes



AKZO NOBEL

Warm Mix Trial at Chico

Main Observations

1. Pug mill Amperage
 - 270°F mix similar to that of the control mix (300)
2. Field Densities
 - Better % relative compaction compared to the control
3. Qualitative assessment of fumes
 - Considerable reduction in fumes, almost no fumes with the 240°F mix

Wider workability window and ease of mixing and compaction



Rediset™ wmx solutions

Distinctive features

1. Directly addresses the issue of moisture sensitivity
2. Moisture not introduced into the mix
3. Low temperature flexibility of asphalt enhanced
4. Formulated to suit a wide spectrum of aggregates
5. Binder and pavement cores can be analyzed for Rediset™ wmx additives



Rediset™ wmx solutions

Other warm-mix benefits

1. Reduction of asphalt fumes
2. Reduce fuel costs
3. Ease of mixing and compaction reduce operational costs
4. Reduce age hardening of the binder (ingredients also function as anti-oxidants)
5. Paving in non-attainment areas, cool weather paving, extend paving season, longer hauls
6. Global concept addressing aggregate quality variability



Warm Mix Trial at Chico

Baldwin Contracting Company comments

“.....extremely positive characteristics at significantly less than standard mixing and placement temperatures””

“At lower temperatures studied in this trial (240F and 270F) compaction efforts were minimized to achieve desired densities ... substantial impact on placement costs Could in fact increase the durability and life of the paved surface.”

“...operational costs including those incurred by fuel consumption should be lowered””



Questions?



AKZO NOBEL
