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Recycle as a Resource

Benefits, Performance, and Equipment Technology

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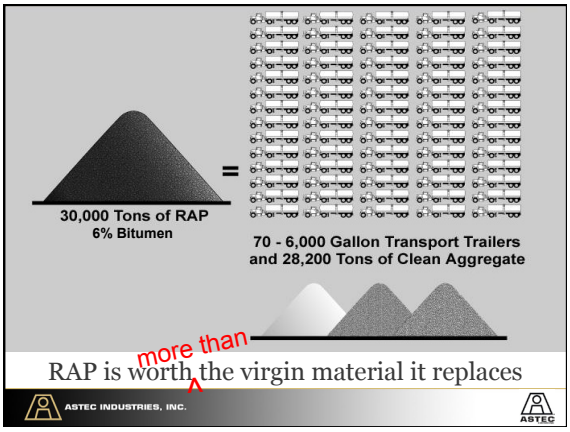
Topics...

- Value of RAP
- Performance of RAP Mixes
- Equipment Technology and Processing

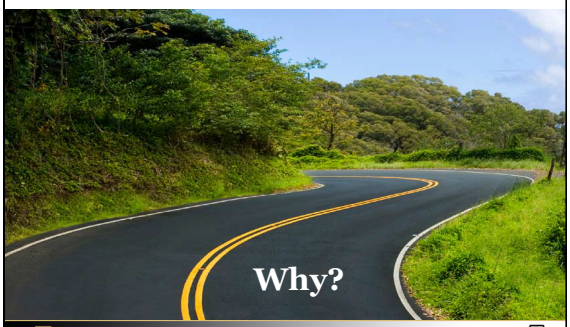
What does GREEN mean?

- Conserving our resources
- Reducing energy cost
- Reducing Greenhouse Emission
- Being more environmentally friendly
- And building a better, longer-lasting pavement

UPHILL BATTLE



Recycle makes a better road



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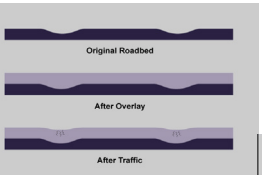
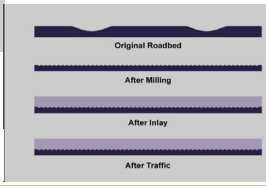
Pavement Quality Issues



Overlays can experience cracks and rutting



Milling and inlays prevent re-rutting

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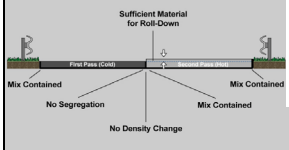
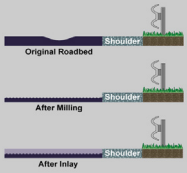
Pavement Quality Issues



Milling ensures consistent paving density



No shoulder or guardrail changes with milling

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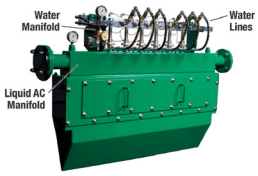
Mechanical Foaming

- Uses water (steam bubbles) to decrease viscosity



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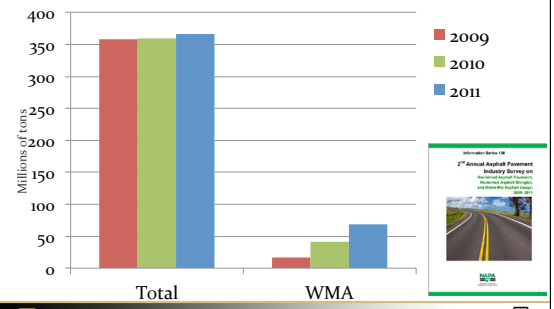
NAPA Survey - Asphalt Pavement Mix US Production



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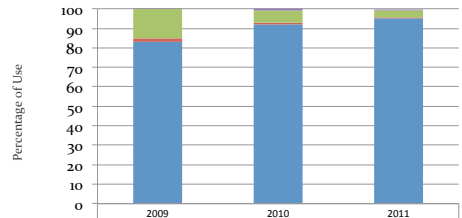

	2009	2010	2011
Organic Additive	0.3	1	0.3
Chemical Additive	15	6	3.8
Additive Foaming	2	1	0.2
Plant Foaming	83	92	95.4

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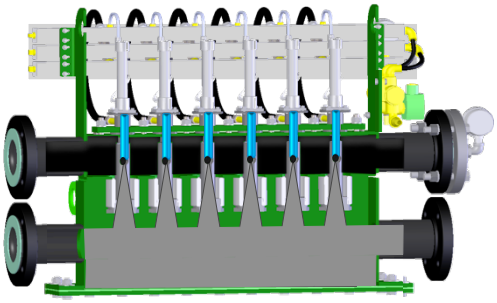
General Process - WMA



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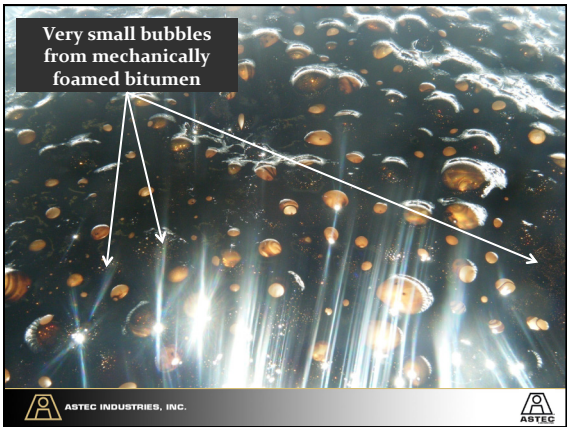

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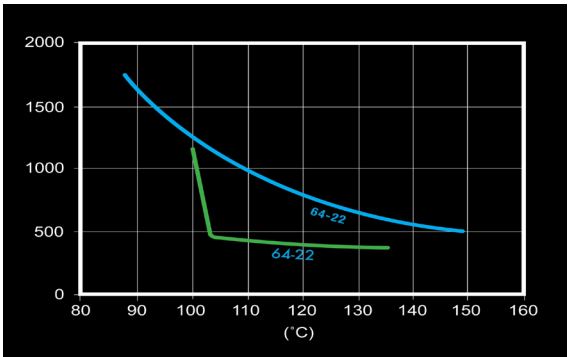

Viscosity vs. Temperature PG64-22 (Approximate)

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NCAT Pavement Test Track

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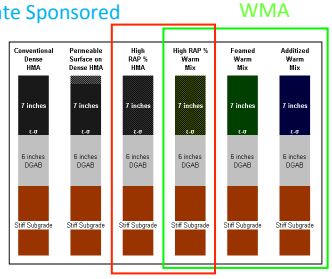
2009 Group Experiment (+)

Six-State Sponsored

WMA



50% RAP

6 Test Sections

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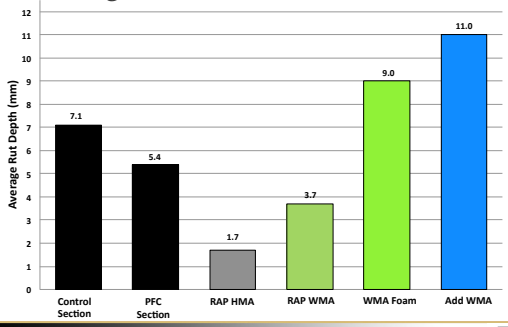
Data courtesy of NCAT

"Rutting" Results



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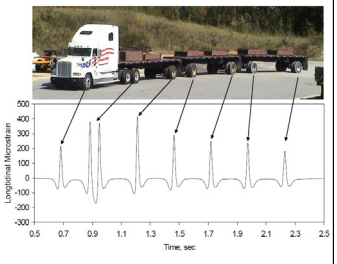
Data courtesy of NCAT

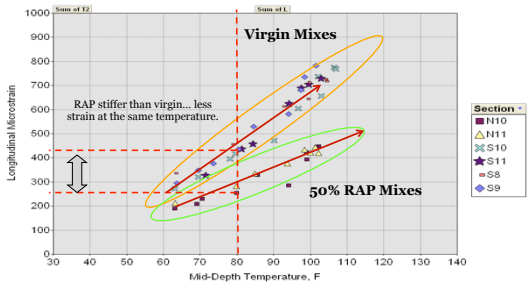
Truck Fleet Operations



ASTEC INDUSTRIES, INC.

Data courtesy of NCAT

Actual Strain Response



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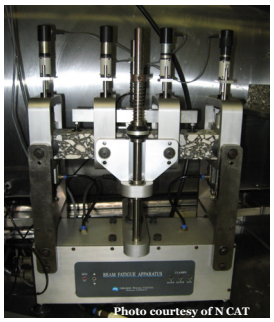
Data courtesy of NCAT

Beam Fatigue Apparatus

- Cyclically applies a set amount of "strain" to the specimen.
- It bends the test specimen (beam) until it fails.



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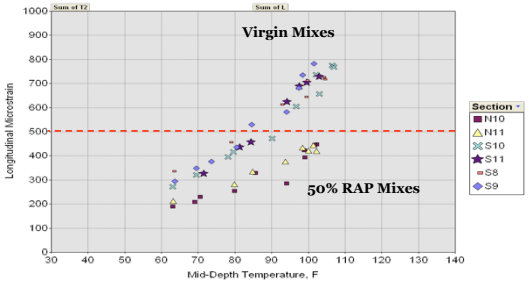
Actual Strain Response



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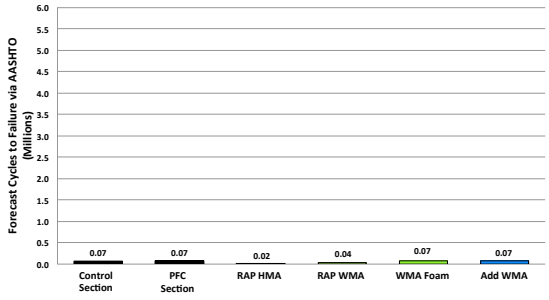
Data courtesy of NCAT

Fatigue Performance Expectations 500



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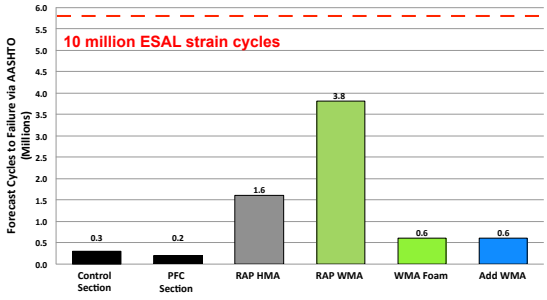
Data courtesy of NCAT

Fatigue Performance Expectations Actual

Virgin @ 350με / RAP @ 250με



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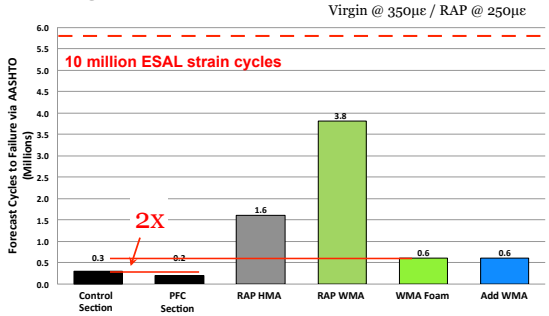

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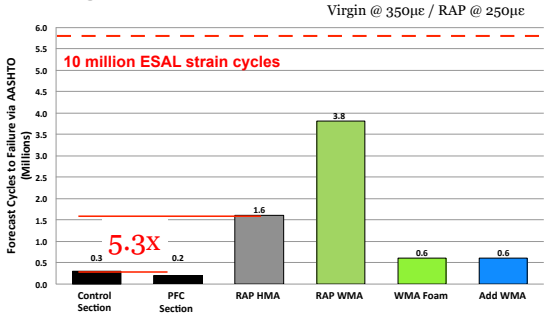

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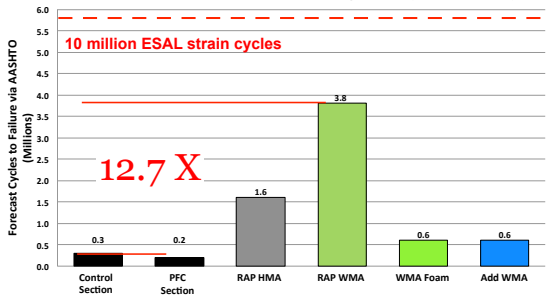

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Data courtesy of NCAT

Other Foamed WMA Benefits

- Use less fuel due to lower temperature (approx. 50F [28C] reduction)
- Less CO_2 emissions and VOC emissions
- Better working conditions / Better neighbor
- Less oxidation of mix
- Can be used as a compaction aid
- Extended hauling distances

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WMA Benefit: Reduced Emissions

Volatile Organic Compounds (VOC)*

Mix Temperature (˚C)	Load-out Emissions (kg/yr)	Silo-filling Emissions (kg/yr)	% Reduction
163	1064	3317	
135	303	945	71.5
127	208	649	80.4

❖ Based upon a plant producing mix at 360TPH with a total yearly production of 544,310 tonnes (600,000 tons) using USEPA emissions factors for HMA production.

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WMA Benefit: Reduced Emissions

Volatile Organic Compounds (VOC)*

Mix Temperature (˚F)	Load-out Emissions (lb/yr)	Silo-filling Emissions (lb/yr)	% Reduction
325	2346	7312	
275	669	2084	71.5
260	459	1430	80.4

❖ Based upon a plant producing mix at 400TPH with a total yearly production of 600,000 tons using USEPA emissions factors for HMA production

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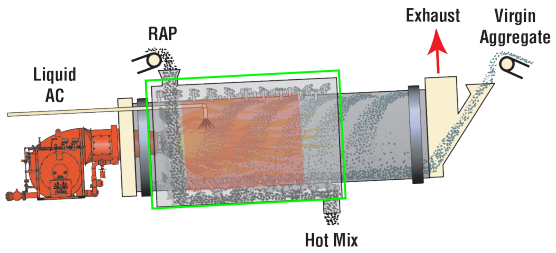
Double Barrel® Combination Dryer Mixer



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Sequential Mixing

- Virgin aggregate mixing begins on collecting conveyor
- Virgin aggregate mixing continues at the scalping (oversize) screen
- Vigorous mixing in the dryer
- Gentle mixing in the mixing chamber

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Vigorous mixing in the dryer.

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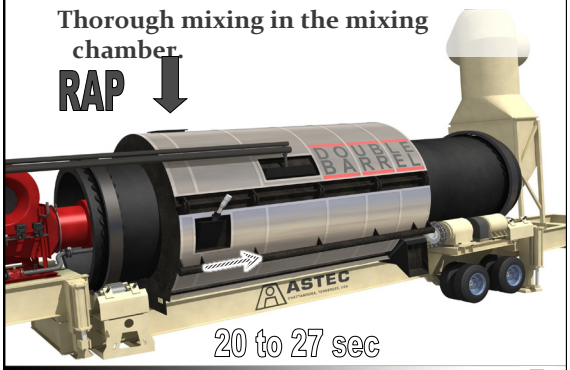
Thorough mixing in the mixing chamber.



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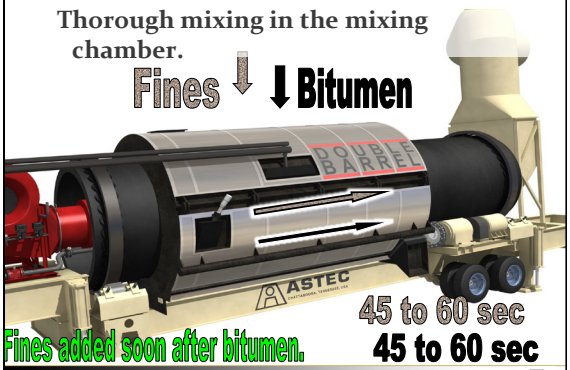
Thorough mixing in the mixing chamber.



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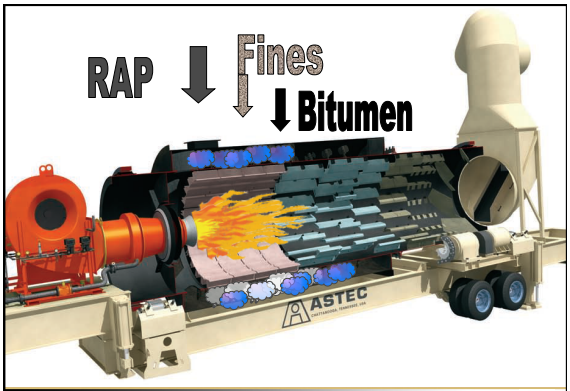

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Conclusions:

- RAP is a RESOURCE
- Milling enhances infrastructure function and maintainability
- RAP and bitumen foaming are not new technologies
- RAP + WMA → longer life pavements (NCAT data)

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