Recycled Asphalt Shingles in HMA

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Pace Construction

- Location St. Louis MO
- Asphalt Production Business since 1932
- Own and Operate 10 Asphalt Plants
- Perform Paving Projects in MO, IL, and AR

Pace Construction

- Shingles, RAP, GTR, Light Bulbs, Floor Tiles, and Sulfur.
- One of the First to Produce and Lay Warm Mix in US.
- Incorporating Shingles/RAP and Warm Mix.

Recycled Asphalt Shingles (RAS)

- Post Consumer Tear Off Shingles
- Supplier Tests For Asbestos on Regular Basic.
- No Hits to This Date
- Asbestos Shingles Have not Been used in Residential Construction since the 70's

Regulations

MO DNR-No Requirements Beyond Local

EPA-NESHAP :40 CFR 61Subpart M for Asbestos

Appendix A

Exempt of Testing Requirements; Shingles from Residential Dwellings in <u>Accordance</u> with Local Requirements

Random Asbestos Testing and Document your Source.

Getting The Ras Into HMA



Getting The Ras Into HMA

- Hard Angular Aggregate
- Fibers & Matting
- Lots of Oil
- Good For HMA

Getting The State on Board

- Eco and Financial Benefits
- 12.5mm SP 5% RAS
- 19.0mm SP 5% RAS
- ▶ PG 64-22
- No Reflective Cracking to This Date.

Getting The State on Board



Pilot Project Rt-67

- > 19.0mm SP 20% Rap PG64-22
- 19.0mm SP 15% Rap 5% RAS PG58–28
- > 12.5mm SP 10% Rap PG 64-22
- Percent Within Limits (Pay Factors)

Pilot Project Rt-67



Results of Pilot Projects

MODOT Drafted a Ras Specification

403.2.6.2 Recycled Asphalt Shingles. Recycled Asphalt Shingles (RAS) may be used in any mixture specified to use PG 64–22 in accordance with AASHTO PP 53 except as follows: A maximum of 7 percent RAS may be used. When the ratio of virgin binder to total binder in the mixture is less than 70 percent, the grade of the virgin binder shall be PG 52–28 or PG 58– 28. Shingles shall be ground to ½–inch minus. Waste, manufacturer or new, shingles shall be essential free of deleterious materials. Post–consumer RAS shall not contain more than 1.5 percent wood by weight or more than 3.0 percent total deleterious by weight. Post–consumer RAS shall be certified to contain less than the maximum allowable amount of asbestos as defined by national or local standards. The gradation of the aggregate may be determined by solvent extraction of the binder or using the following as a standard gradation:

Shingle Aggregate Gradation

Sieve Size Percent	Passing by Weight
3/8 in. (9.5 mm)	100
No. 4 (4.75 mm)	95
No. 8 (2.36 mm)	85
No. 16 (1.18 mm)	70
No. 30 (600 µm)	50
No. 50 (300 µm)	45
No. 100 (150 µm)	35

Results of Pilot Projects

Needed a Finer Grind



Results of Pilot Projects



	12.5MM SP 20% RAP		
Gmm	2.448		
Gmb	2.349		
VA	4.0	1⁄2	98.2
VMA	15.0	3/8	89.6
D/B	1.1	#4	63.8
Pbe	4.7	#8	37.5
Pba	0.9	#16	23.4
Virgin AC	4.7%	#30	15.2
AC From RAP	0.9%	#50	11.7
Total AC	5.6%	#100	7.8
		#200	5.1

	12.5MM SP 18% RAP 2% RAS		
Gmm	2.452		
Gmb	2.341		
VA	4.5	1⁄2	98.2
VMA	15.2	3/8	89.7
D/B	1.2	#4	64.2
Pbe	4.6	#8	38.2
Pba	1.0	#16	24.1
Virgin AC	4.2%	#30	15.7
AC From RAP	0.8%	#50	12.0
AC From RAS	0.6%	#100	8.2
Total AC	5.6%	#200	5.6

	12.5mm 20% RAP	12.5mm 18% RAP 2% RAS
Pbe	4.7%	4.6%
lgnition Oven Burn	5.6%	5.6%

100% of RAS Oil
Does Not Release

 Lower Effective Binder Equals Higher Voids



- RAS AC Stiffens or Modifies your Binder
- Could Change Your Molding Temp.
- PG 64–22 Mold Temp 295F–305F
- PG 70–22 Mold Temp 305F–310F

What Does The RAS do to Your Binder

- ▶ PG 58-22
- RAS AC Content 16.3%
- 5% RAS
- Virgin Oil Content 4.0%
- ▶ 16.3% RAS AC x 5% RAS=0.8%
- Total AC 4.8%
- RAS Oil Makes up 17% of Total AC Content

What Does The RAS do to Your Binder

	Property	Criteria
Original DSR 64C 70C	2.77 kPa 1.30 kPa	1.00kPa min
RTFO DSR 64C 70C	4.58 kPa 2.12 kPa	2.20 kPa min
PAV DSR	4043 kPa	5000 kPa max
BBR @-12C Stiffness M-value	172 MPa .315	300 Mpa 0.300 min

What Does The RAS do to Your Binder



Where are We Heading?

RAS in Warm Mix

RAS in Open Graded Mixes

Pooled Fund Study

RAS in HMA

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Questions?