ISAP Asphalt Pavement and Environment

WG 5 Asphalt Shingles

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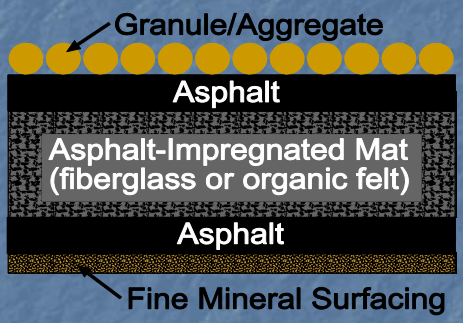
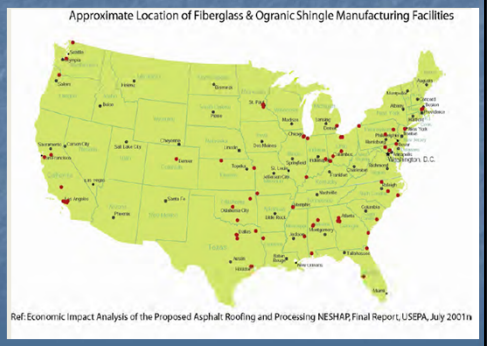
Composition of Asphalt Shingles



All materials commonly used in asphalt pavements

Sources of Asphalt Shingles

- Manufactures' waste
  - Approx. 1,000,000 tons annually
  - Not in every state
- Post-Consumer
  - Approx. 10,000,000 tons annually
  - Available everywhere



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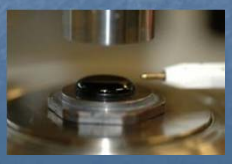
U.S. Shingle Use (tons) in HMA

- Use is Growing
- 2010
  - 26 states using RAS
- 2011
  - 32 states using RAS

Quantifying Performance

- ✓ Effect on Binder Grade
- ✓ Rutting resistance
- ✓ Low Temperature
- ✓ Fatigue
- ✓ Moisture Susceptibility



Field Use Outpacing Research

- Five to 10 years of use
  - Longer use of Manufacture's Waste
  - More recent use of Post Consumer
- Typical Use
  - 3 to 5%
  - (10 to 20% asphalt binder replacement)

Research Findings

- Three to five years of research
- Cracking Evaluation
  - Generally negative to slightly negative
- Field Performance
  - Clear picture not yet available

Mix Design

- RAS Design Similar to RAP Design
- AASHTO Guidance
  - PP 53-09 Design Considerations when Using Reclaimed Asphalt Shingles in New HMA
  - MP 15-06, *Use of Reclaimed Asphalt Shingle as an Additive in Hot-Mix Asphalt*

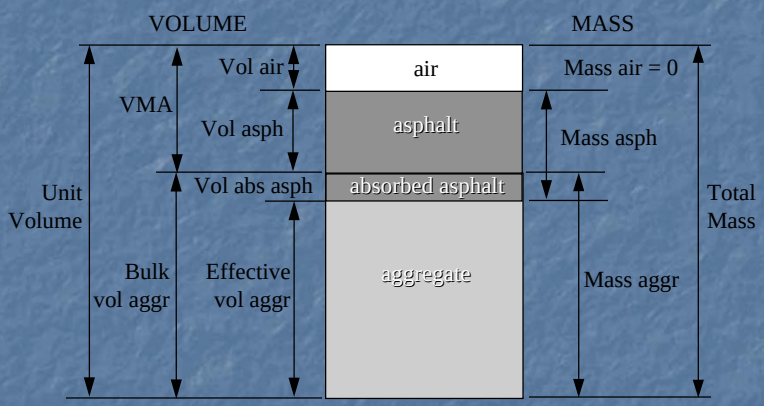
Availability Factor

- Based on concept
  - Hardness of asphalt binder
  - Reduces ability to be asphalt binder
- PP 53
  - Evaluation method to evaluate availability

Availability of Asphalt Binder

- AASHTO PP 53, Section 6
  - Volumetric design w/o shingles
    - Design asphalt content
  - Add Shingles to design
    - Design asphalt content
  - Evaluate Difference in %AC
    - Increased design asphalt content
    - Asphalt binder from shingles
  - Calculate availability factor

Back to Basics



Hypothesis

- Mineral Matter in shingle increases VMA
  - Increase greater than volume of asphalt in shingles
    - Air voids increase
  - Increase less than volume of asphalt in shingles
    - Air voids decrease
- Has nothing to do with “availability”

Experiment

- Design mixture with no shingles
- Add shingles (with full asphalt content)
  - Calculate VMA and air voids
- Add shingles (with half normal asphalt content)
  - Calculate VMA and air voids
- Add shingles (with no asphalt content)
  - Calculate VMA and air voids

Materials

- Crushed Stone
- Stone Sand
- Natural Sand
- Baghouse Fines
- PG 64-22
- Post Consumer Shingles


Crushed Stone


Stone Sand


Natural Sand


Baghouse Fines


Shingles


+ 4


+8


+16


+30


-30

Extracting Shingles

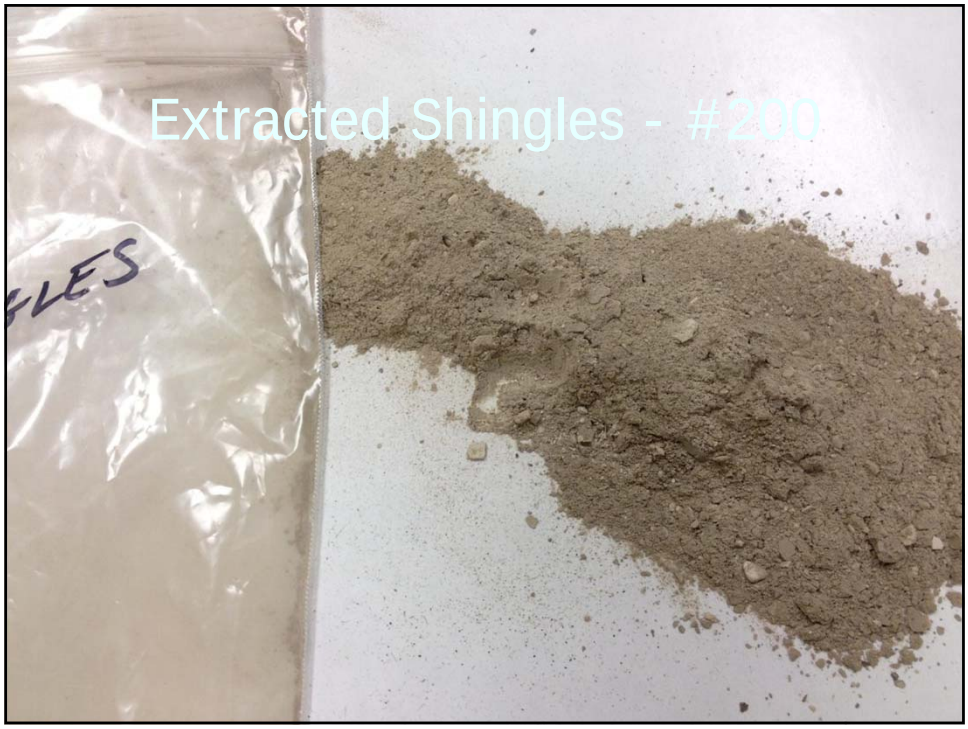
Extracting Shingles


Extracted Shingles


Extracted Shingles - #4


Extracted Shingles - #30


Extracted Shingles - #100



Volumetric Properties of Mixes

	Virgin	5% Shingles (23% asphalt)	5% Shingles (11.5% asphalt)	5% Shingles (0% asphalt)
Air Voids	4.0	6.4	5.9	5.8
Gsb	2.708	2.701	2.701	2.701
VMA	15.5	17.3	17.0	17.0
Asphalt %	5.8 / 0.0	4.65 / 1.15	5.22 / 0.58	5.8 / 0.0
Pba (absorption)	0.92	1.07	1.02	0.96

Evaluating Volumetric Properties

	Virgin 0% shingles	5% Shingles (23% asphalt)	5% Shingles (11.5% asphalt)	5% Shingles (0% asphalt)
Air Voids	4.0	6.4	5.9	5.8
Change in VMA	-	+1.8	+1.5	+1.5
Change in Pba (volume basis)	-	+0.4	+0.2	+0.1
Expect Change Air Voids	-	+2.2	+1.7	+1.6
Actual Change Air Voids	-	+2.4	+1.9	+1.8
Error		0.2	0.2	0.2

Experiment Results

- Change in air voids
  - From change in VMA
- Change in VMA
  - From mineral matter in shingles
- Adding asphalt to fill increased air voids
  - Not related to properties of asphalt binder in shingles.

Experiment Recommendations

- Remove Shingle Binder Availability Factor from PP 53.

Summary

- Use Growing
  - Driven by economics
- Technical Considerations
  - Non-uniform standards
- Field Performance
  - Positive (to date)

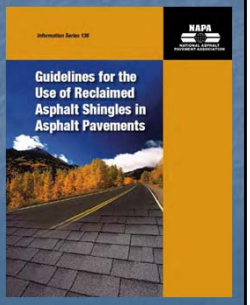
Additional Information .....

FHWA Pavement & Material Web Site

http://www.fhwa.dot.gov/pavement

National Asphalt Pavement Association

http://www.asphaltpavement.org



And .....

http://shinglerecycling.org/