The Cardiac Arrest of Hot Mix Asphalt Pavements

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Murphy Pavement Technology
Our Job is to Evaluate Risk

Rugged review of practices with numerous agencies and contractors throughout the nation has been performed over 20+ years.

Text in your Q: 773-874-9800
Speaking of 2017
Segregation is the...

“non-uniform distribution of the various aggregate sizes throughout the mass”
Separation of Coarse & Fine Materials
Separation of Coarse & Fine Materials
Segregation of Asphalt Mixtures

Segregation May Occur Because Of:

- Mix Designs
- Aggregate Handling
- Asphalt Plant Particulars
- Truck Loading & Unloading
- Paver Operations
Segregation of Asphalt Mixtures

Mix Designs (Gap-Graded)

- Job-Mix Formula Not Well Graded Down Through Fines
- Steep Grading Curve

Large Stone Present Challenges
Decisions Must Be Made to Avoid a Re-count
Large Top Size plus Gap Grading = Trouble
Big Rock Requires Attention to Detail
Increase Effective Volume of Asphalt

Voids in the Mineral Aggregate (VMA) equals the Effective Volume of Asphalt (Vbe) plus Air Voids (Va)

\[ V_{be} = V_{MA} - V_a \]
Evaluation of Asphalt Absorption by Mineral Aggregate

Asphalt Absorption vs. Aging

Curves vary from aggregate to aggregate.

PG58-28

PG64-22

Evaluation of Asphalt Absorption by Mineral Aggregate
Laboratory Mixture Analysis

Segregation Potential?
- Batch Sample in Laboratory
- Discharge Sample 1 meter
- Analyze Segregated Sample
Laboratory Mixture Analysis
Laboratory Mixture Analysis
Laboratory Mixture Analysis
# Laboratory Mixture Analysis

<table>
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<tr>
<th>Sieve Size</th>
<th>Outside</th>
<th>Inside</th>
<th>Factor</th>
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<td>12.5mm (1/2&quot;)</td>
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<td>100</td>
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<tr>
<td>4.75mm (#4)</td>
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<td><strong>Marshall Data</strong></td>
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<td>5.8</td>
<td>0.3</td>
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<tr>
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<td>3.6</td>
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<td>Stability/Flow</td>
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Segregation of Asphalt Mixtures

Segregation May Lead To:

– Smoothness Problems
– Density Below Specification
– Loss Of Overall Mat Durability
Where do we cause segregation to happen?

- At the Plant?
- During Haul?
- Paver?
- On the Mat?
Segregation of Asphalt Mixtures

Aggregate Handling
- Producer Stockpiles
- End User Stockpiles
- Loading Cold Bins
Segregation of Asphalt Mixtures

Aggregate Handling

Dirty Core, Fine Aggregate

Medium Coarse Aggregate

Conveyor

Coarse Aggregate
Segregation of Asphalt Mixtures

In General, Segregation Potential Increases the More a Material is Handled.
Cut-Away of Aggregate Handling of Windrow
Segregation of Asphalt Mixtures

Asphalt Plant Particulars
(After Cold Bin Feeding)

- Drum Mixers
- Hot Bins on Batch Plants
- Surge & Storage Bins
Head Pulley and Main Weigh Bridge Discharge
Head Pulley and Main Weigh Bridge Discharge
Segregation of Asphalt Mixtures

Drum Mixers

Segregation During Drum Discharge
“B” momentarily stops and “rebounds” back to “A”.

“A” catches up to “B”, stops shorter time due to less rebound energy—separation reduces!

Separation begins again.

On to next baffle.
Segregation of Asphalt Mixtures

Drum Mixers

Homogenous Uniformity During Drum Discharge By Fixing a Plow At Point of Discharge
Segregation of Asphalt Mixtures

Drum Mixers

Uniformity During Drum Discharge
By Turning Drag Chain 90°
Batch Plant Bin #1

Baffle Plate

Sounders

HOT BIN SEGREGATION
Minimizing Silo Segregation

Always use batcher or “gob” hopper

Maintain as uniform height of mix as possible 30-70%

Load out trucks in multiple drops.
Segregation of Asphalt Mixtures
Segregation of Asphalt Mixtures

Doghouse fillets

Doghouse baffles

TRUCK MOVED TO 3 DISCHARGE POSITIONS.
Segregation of Asphalt Mixtures

Truck Unloading

– Tip the Truck Bed Prior to Releasing Tailgate
– Baffles at the Point of Discharge
– Flood the Paver Hopper
End of load segregation with belly-dump.
Segregation of Asphalt Mixtures

Segregation May Lead To: (Cont’d.)

- Moisture Damage & Raveling
- Cracking
- Streaky Pavement Surfaces
Segregation Leads to Failure

Moisture Often Plays a Role
Moisture Damage from Segregation
Far-Away of HMA
Segregation of Asphalt Mixtures

Streaky Pavement Surfaces Resemble:

- Chevrons
- Longitudinal Streaks
- Blotchy Areas
Segregation of Asphalt Mixtures

Paver Operation

– Keep The Paver Moving
– Maintain 25% Capacity in Hopper
– Dump Wings Only When Material is in Hopper
Paver Operation

GOOD!!!

BAD!!!
Segregation of Asphalt Mixtures

Paver Operation (Cont’d.)

– Fillets in Corners
– Kick-Back Plates
– Head in Augers
– Auger Extensions
Paver Operation, Hopper
Superpave Specification Requirement

Reverse screw augers with a minimum efficiency of 75% shall be installed at the gear box for all paving activities.
Longitudinal Cracking Mitigation
Longitudinal Cracking Mitigation
Extended screeds must be installed...

Extended screeds shall be provided with corresponding auger and tunnel extensions to ensure a uniform head of fresh material across the entire screed.
Right side segregation.
My mother always told me, 'The devil is in the details.'
Bearing / hanger
Model Segregation Specification

Agencies now use one of the following for quantifying segregation:

- Deviation from the approved JMF via extraction
- Sand patch measurement
- Nuclear density gauge
Model Segregation Specification:
Measuring Segregation with a Nuke Gauge
A Few References on Segregation

**Enhanced MS-22 Coming Soon...**
**Just Ask Wayne!**
Infrared Photo
(End Dump Mix Behind Paver)
Real-time PAVE-IR (from MOBA)
Real-time PAVE-IR (from MOBA)
Segregation of Asphalt Mixtures

Homogeneous Asphalt Mixtures Ensure Us Of Having

Smotherer and More Durable Asphalt Pavements
Murphy’s Material Minute

Asphalt Production & Construction:

‘Use all equipment in accordance with the manufacturers recommendation.’
Questions?

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