Chip Seals: Replacing ‘Art’ With Science

by
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Maintenance 206
Rocky Mountain Asphalt Conference and Equipment Show
What Are Chip Seals?
Traffic Control
Questions...
Aggregate
Aggregate

• Spread Rate
  – One Stone Thick
Aggregate

- Spread Rate
  - One Stone Thick
Aggregate

- Spread Rate
  - One Stone Thick

- Or.....
Aggregate

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– Or.....
Aggregate

- Spread Rate
  - One Stone Thick

- Or.....
Getting it One Stone Thick
Getting it One Stone Thick

- Follow A Design Method
  - South Africa/Australia/New Zealand/Hanson
    - Flakiness Index < 25%
    - ALD/Gradation - One-Sized
    - Traffic
    - Texture
    - Embedment
Getting it One Stone Thick

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    • Embedment
  – Asphalt Institute/McLeod/Hanson
    • Asphalt Rates Too Low, Aggregate Rates Too High
Getting it One Stone Thick

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    - Asphalt Rates Too Low, Aggregate Rates Too High
  - Texas/Kearby/Gallaway
    - Asphalt Rates Too Low, Aggregate Rates Too Low
Objective: Replacing ‘Art’ with Science
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- Turning Traffic Loose/Sweeping
- Surface Texture
Objective: Replacing ‘Art’ with Science

- Turning Traffic Loose/Sweeping
- Surface Texture
- Surface Resistance
Objective: Replacing ‘Art’ with Science

• Turning Traffic Loose/Sweeping

• Surface Texture

• Surface Resistance
Objective: Replacing ‘Art’ with Science

- Turning Traffic Loose/Sweeping
- Surface Texture
- Surface Resistance
- Emulsion Correct on Job?
Question
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• Can a Lab Test be Used to Predict When to Broom/Turn Traffic Loose on a Chip Seal?
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• If Used:
  – Judgment Could be Improved,
  – Windshields Saved,
  – Reputations Maintained,
  – More Chip Seals Would be Built
  – The deficit would be eliminated
Chips at One-Stone Thickness
“Pin-Art” Holds Chips
The ‘Grabber’
Template = 40% Embedment
A Pneumatic Roller Would be an Improvement
NCHRP 14-17
“Broom Simulator”
The Experiment
The Experiment

• AGGREGATES:
  – Basalt, Alluvial, Granite, Limestone
The Experiment

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- EMULSIONS:
The Experiment

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- EMULSIONS:
- EMULSION CURE:
  - 40%, 80%
The Experiment

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  - Basalt, Alluvial, Granite, Limestone

- **EMULSIONS:**

- **EMULSION CURE:**
  - 40%, 80%

- **AGGREGATE MOISTURE:**
  - Dry, SSD
Chip Loss
Field Site Aggregates - Lab Sweep Test Results

Dry Aggregate
Chip Loss, % = -1.2179(Moisture Loss, %) + 98.203
$R^2 = 0.8254$

SSD Aggregate
Chip Loss, % = -1.3453(Moisture Loss, %) + 105.33
$R^2 = 0.9283$

At About 70 to 75% Moisture Loss
Chip Loss
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At About 70 to 75% Moisture Loss
So the Lab Test Seems to Work,
Forks, WA
Is the Emulsion What You Want?
20 to 70 seconds at 85 to 150F for a 6 mm orifice
or
10 to 60 seconds at 85 to 140F for a 7.5 mm orifice
Will Chips Disappear Into Substrate?
Will Pavement Texture Swallow Emulsion?
Surface Texture Correction
U. S. Customary Units

Correction, gal/yd²

Sand Patch Diameter*, in.
(*based on 1.5 in³ sand volume)
How Much are the Chips Embedded ?
Conclusions
Conclusions

• The amount of water remaining in the chip seal (emulsion, chips, substrate) seems to have an effect on chip retention.
Conclusions
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• The Modified Sweep Test may provide a means to Determine What Moisture Content is Appropriate Before Opening To Traffic/Sweeping.
Conclusions
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• Significantly higher chip loss was measured for test specimens fabricated with dry aggregates compared with saturated surface dry aggregates.
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• Simple, Practical, Quantitative Methods Were developed for:
  
  Estimating When ‘Traffic/Broom Ready’
  Embedment Depth
  Surface ‘Softness’
  Emulsion Viscosity
  Surface Texture
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A1 Chip Seal
Texas Transportation Institute
Questions ?
Thank You !