New Chip Seal Technology

by

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TRB Preventive Maintenance Committee
Acknowledgements

National Cooperative Highway Research Program

Project 14-17 “Manual for Emulsion-Based Chip Seals for Pavement Preservation”

FHWA Federal Lands
City of Frederick, Colorado
Washington DOT
Texas Transportation Institute
Objective: Replacing ‘Art’ with Science

- Turning Traffic Loose/Sweeping
- Surface Texture
- Surface Resistance
- Emulsion Correct on Job?
Question

• Can a Lab Test Can be Used to Predict When to Broom/Turn Traffic Loose on a Chip Seal

• If Used:
  – Judgment Could be Improved,
  – Windshields Saved,
  – Reputations Maintained,
  – More Chip Seals Would be Built
  – The deficit would be eliminated
  – World Peace would follow
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

• AGGREGATES:
  – Basalt, Alluvial, Granite, Limestone

• EMULSIONS:
  – RS-2, RS-2P, CRS-2, CRS-2P

• EMULSION CURE:
  – 40%, 80%

• AGGREGATE MOISTURE:
  – Dry, SSD
Step 2 - Determine the Moisture Content Where <10% Chip Loss Occurs with Field Materials

**Dry Aggregate**

Chip Loss, % = \(-1.2179 \text{(Moisture Loss, %)} + 98.203\)

\(R^2 = 0.8254\)

**SSD Aggregate**

Chip Loss, % = \(-1.3453 \text{(Moisture Loss, %)} + 105.33\)

\(R^2 = 0.9283\)

At About 70 to 75% Moisture Loss

Field Site Aggregates - Lab Sweep Test Results
So the Lab Test Seems to Work, 
Does This Relate to the Field?
Step 3 - Build Three Full-Scale Chip Seals and Compare Moisture Content to Chip Adhesion

Architects Natl Park, UT
Frederick, CO US101, WA

Resists Broom and Traffic

Field Moisture Loss, %
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?
Surface Too Soft for Chip Seal Above this Line

Above Line C
Correction = -0.06 gal/yd² (-0.30 L/m²)

From Line B to C
Correction = -0.04 gal/yd² (-0.20 L/m²)

From Line A to B
Correction = -0.02 gal/yd² (-0.1 L/m²)

No Correction Needed this side of Line A

Traffic, Veh/day/lane

Ball Penetration, mm
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

• The amount of water remaining in the chip seal (emulsion, chips, substrate) seems to have an effect on chip retention.
Conclusions

• The Modified Sweep Test may provide a means to Determine What Moisture Content is Appropriate Before Opening To Traffic/Sweeping.
Conclusions

• Significantly higher chip loss was measured for test specimens fabricated with dry aggregates compared with saturated surface dry aggregates.
Conclusions

• No significant differences in chip loss could be measured either at 40 or 80 percent cure when cationic emulsions were compared with anionic emulsions on either calcareous or siliceous aggregates.
Conclusions

• Simple, Practical Quantitative Methods Were developed for:

  Embedment Depth
  Surface ‘Softness’
  Emulsion Viscosity
  Surface Texture
Thank You!