Chip Seal – Part 2

Columbus, Ohio
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Class Outline

Topic 5: Design Formulas

Topic 6: Calibration

Topic 7: Equipment

Topic 8: Construction
**Average Least Dimension (H)**

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**Embedment (0.7 H)**

How is the Average Least Dimension calculated?

**Inputs:**  Median Particle Size, Flakiness Index
**Median Particle Size**

- Determined from the gradation chart.
- The theoretical sieve size through which 50 percent of the material passes (50 percent passing size).
Design Formulas

Median Particle Size (0.215 in.)

Percent Passing

Sieve Opening (inches)
Average Least Dimension (H)

\[ H = \left[ \frac{M}{1.139285 + (0.011506)FI} \right] \]

Where:
- \( H \) = Average Least Dimension
- \( M \) = Median Particle Size
- \( FI \) = Flakiness Index
Loose Unit Weight of Cover Aggregate

- Necessary to determine voids present
Design Formulas

Loose Unit Weight of Cover Aggregate
Voids in Loose Aggregate

\[ V = 1 - \frac{W}{62.4 \, G} \]

Where:
- \( V \) = Voids in Loose Aggregate (percent)
- \( W \) = Loose Unit Weight of Cover Aggregate (ASTM C 29)
- \( G \) = Bulk Specific Gravity
Aggregate Application Rate

\[ C = 46.8 \ (1 - 0.4V) \ HGE \]

Where:
- **C** = Cover Aggregate Application Rate, lbs/yd²
- **V** = Voids in Loose Aggregate (percent expressed as decimal)
- **H** = Average Least Dimension (expressed as decimal inch)
- **G** = Bulk Specific Gravity of Aggregate
- **E** = Wastage Factor for Sweeping (from Table)
Emulsion Application Rate

\[ B = \frac{(2.244)HTV+S+A}{R} \]

Where:  
- \( B \) = Emulsified Asphalt Application Rate, gal/\( \text{yd}^2 \)  
- \( H \) = Average Least Dimension (expressed as decimal inch)  
- \( T \) = Traffic Factor  
- \( V \) = Voids in Loose Aggregate (percent expressed as decimal)  
- \( S \) = Pavement Surface Texture (from Table)  
- \( A \) = Aggregate Absorption Factor (from Table)  
- \( R \) = Residue Asphalt Content of Emulsion
Part 6

Calibration

Distributor Spray Bar
Calibration

CORRECT
Sprayer Nozzles at Same Angle

15 to 30 degrees

INCORRECT
Sprayer Nozzles at Different Angles

variable angles

Spray Bar Nozzle Alignment
Calibration

Same Angle

Different Angles

Fans are the same width

Fans are different widths

Spray Bar Nozzle Alignment
Calibration

Spray Bar Nozzle Alignment

Nozzle Slot 30° from Spray Bar

30°
Calibration

Triple-Lap Coverage

With nozzles on 4\textquoteleft\textquoteleft centers, material sprayed from each nozzle overlaps two other sprays.
Calibration

Adjusting Spray Bar Height

Too High = Ridges  
Too Low = Gaps
Calibration

Improper Spray Bar Height
Calibration

Distributor Controls
#6 Recommended for Chip Seals  
Match Nozzles to Application
Calibration

Calibrating Spray Bar
Calibration

Aggregate Spreader
Calibrating Aggregate Spreader

ASTM D5624-95
Calibration

Calibrating Aggregate Spreader
Calibration

Calibrating Aggregate Spreader
Calibration

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Calibration

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Calibration

Calibrating Aggregate Spreader
Calibration

Properly Calibrated Aggregate Spreader
Asphalt Distributor Truck

- Distributor shall have a ground speed control device interconnected with the emulsified asphalt pump
- Capable of maintaining the specified application rate within +/- 0.015 gal/yd² for each load
Equipment

Asphalt Distributor
Asphalt Distributor Truck

- Regulate the amount of asphalt sprayed on the roadway
- Regulate spray pattern
- Typical spray bar width is 12 feet wide
- Extended spray bar width is up to 24 feet
- Nozzles evenly spaced (every 4 inches)
Equipment & Construction

Asphalt Distributor Preparation

- Calibrate
- Blow nozzles
- Check bar height
- Check transverse alignment
- Check emulsion temperature
- Ensure adequate emulsion supply
Equipment

Aggregate Spreader

- Self-propelled mounted on pneumatic-tired wheels
- Computerized spread control
- Adjustable gates capable of distributing aggregate at the designed rate
Equipment

Pneumatic Rollers
Pneumatic Rollers

- Rollers capable of ballast loading to allow weight to be varied from 6 to 8 tons
- Minimum contact pressure of 80 lbs/in² to achieve aggregate mechanical interlock
- All tires shall be as supplied by the roller manufacturer
Equipment

Pneumatic Rubber Tire Rollers
Equipment

Pneumatic Rubber Tires

Rear Tires

Front Tires
Sweepers

- Clean existing roadway before chip seal application
- Remove excess aggregate from completed seals
- Types include: Rotary, Pick-up, and Vacuum Brooms
Equipment

Pick up Sweeper
Equipment

Angle Sweeper – Kick Broom
## Weather Conditions for Construction

<table>
<thead>
<tr>
<th>Condition</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Air Temperature</td>
<td>High</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>Low</td>
</tr>
<tr>
<td>Wind Velocity</td>
<td>Minimal</td>
</tr>
<tr>
<td>Precipitation</td>
<td>None</td>
</tr>
</tbody>
</table>
Temperature Considerations

- Ambient air temperature should be above 60º F for asphalt emulsions
- Roadway surface >60º F and <130º F
Construction

Consider Pavement Temperature
Construction

Irrigation Runoff
Construction

Crack Filling
Surface Preparation

- Repair surface holes and depressions
- Level surface irregularities affecting ride
- Remove all excessive asphalt (patches / joints)
- Mill surface if extensive loose material
- Crack fill (all larger cracks >\(\frac{1}{8}\)"")
- Remove pavement markers & delineators
- Clean roadway – full width (sweeping)
Construction

Place Paper at Start of Run
Construction

Pneumatic Rollers

• Orient particles to their least dimension

• Use a minimum of 3 rollers and position in echelon to cover the entire lane width

• Maintain speed less than or equal to three miles per hour

• Three complete roller passes of the aggregate chips are required.
Construction

Temporary Markers
Construction

Traffic Control
Construction

Sweeping

- Sweep within 3 hours of placement
- Never open to traffic without sweeping
- Re-sweep prior to opening to unrestricted traffic
Fog Sealing
Construction

Application of Fog Seal

- Fog seal all chip seal areas after sweeping and before placing permanent pavement markings
- Diluted emulsified asphalt should be initially applied at an application rate of 0.06 to 0.12 gal/yd².
- Construct a 100 foot test strip and adjust application rate as needed.
Construction

• Use SS-1h or CSS-1h emulsified asphalt
Construction

- Use diluted asphalt emulsion with not less than 28% residue
Fog Seal Basics

- No rain forecasted (3 hour minimum)
- Environmental conditions dictate time of cure
- Nozzles sized for uniform application
- Distributor is calibrated and working properly
- Operator is trained and qualified
- Overlap centerline at $\geq 1$ foot
- Lightly sand intersections & higher use areas
Fog Seal Benefits

1. Accelerates curing of pavement because of dark color
2. Harder asphalt over top of the soft elastomeric asphalt underneath
3. Locks down marginally embedded chips
4. Reduces amount of paint needed and makes pavement marking more visible
5. Limits snowplow damage
Construction

Final Product
Construction

Customers perceive new overlay
Construction

Chip seal after 5 months
## Recommended Basis of Payment

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>State ##</td>
<td>Emulsified asphalt for Chip Seal</td>
<td>Gallon</td>
</tr>
<tr>
<td>State ##</td>
<td>Diluted emulsified asphalt for Fog Seal</td>
<td>Gallon</td>
</tr>
<tr>
<td>State ##</td>
<td>Aggregate used in the Chip Seal</td>
<td>Square Yard</td>
</tr>
</tbody>
</table>
Framework for Success

It is the:

“right” treatment on the
“right” road at the
“right” time by the
“right” people
Questions
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