Chip Seal Best Practices Training
Session One

Presented by
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June 2015

Introduction to Chip Seals

NCDOT 70 Years

- Began in 1940’s
- Dust suppression and roadway stability
- Backbone of NCDOT’s Secondary Road System

Known as:

- Road Oil
- Tar and Gravel
- Bituminous Surface Treatment (BST)
- Asphalt Surface Treatment (AST)
- Chip Seal
- Chip Seal – Layer of Emulsion, followed by a Layer of Aggregate
Introduction to Chip Seals

NCDOT Today

• Approximately 60,000 centerline miles on secondary road system
• 44% or 26,300 centerline miles are Chip Seals

Benefits

• Water proof
• Increased skid numbers
• Extend pavement life 5 to 7 years
• Cost

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Introduction to Chip Seals

NCDOT Secondary Road Deterioration Curve
Introduction to Chip Seals

Historical Concerns:
- No structural enhancement or coefficient
- Loose Rocks (Early in Life)
- Noise
- Rougher Ride
- Perceived Lesser Ride Quality

Introduction to Chip Seals
- Applying Chip Seals is an "Art"
- Applying Chip Seal Treatment is not Plant Mix Paving or Microsurfacing Paving
- Chip Seal Treatment requires experience because of variability and ever changing conditions
- NCDOT is working towards a Contractor Certification program
- Today we want to share our experiences

Next Section: Existing Roadway
Existing Roadway

- Wearing course or protective skin to stop water intrusion
- Existing profile or shape will be same after Chip Seal Treatment
- Repairs must be complete before Chip Seal Treatment
- Roadway must be free of dust and debris
- Used on Right Road at the Right Time is the Right Application
- Used on Wrong Road at any time will lead to a Disaster
- Repairs potentially included in future NCDOT contracts

Existing Roadway

Good Repair for Surface Type Distresses

- Oxidation
- Top down cracking
- Bleeding
- Raveling

Existing Roadway

Wrong Treatment for Substructural or Structural Distresses

- Rutting
- Bottom up cracking
- Severe Alligator cracking
Next Section: Equipment and Calibration

Equipment and Calibration

Distributor

- Shoot between .20 and .50 gallons per square yard
- Uniform layer emulsion
- 8 to 14 foot spray bar
- Circulating tank for emulsion
- Elements to heat emulsion
- 15 to 30 degree nozzle angle
- Proper spray bar height

Equipment and Calibration

Spreader

- Uniform layer of aggregate
- Self-propelled
- Front and rear hoppers for aggregate receivable and spreading
- Adjustable gates on front
- Spreader boxes available and fixed or adjustable widths
Equipment and Calibration

**Dump Trucks**
- Deliver aggregate
- Hitch allows for connection to spreader for towing down the road
- Dump fins for aggregate control

**Equipment and Calibration**

**Pneumatic Roller**
- Follow contour of road
- Follows spreader in sequence
- Reorientation of aggregate

**Static Steel Wheel Roller**
- Follows pneumatic roller
- Helps seat the aggregate into the emulsion
- Provides smoother finish

**Equipment and Calibration**

**Combination Rollers**
- Best of both worlds
- Can replace steel wheel
Equipment and Calibration

Mechanical Broom

- First and last thing on your project
- Pre Pave - Remove dirt and debris to clean surface
- Post Pave - Remove the loose aggregate

Equipment and Calibration

Vacuum Truck

- Less abrasive
- More expensive
- Only use after Chip Seal Treatment

Next Section: Calibration
Calibration

Nozzle 15 to 30 degrees

Reminder:
• Nozzle size effects application rate

Good Nozzle Angle
Bad Nozzle Angle

Calibration

• Height of spray bar for single, double, and triple coverage
• Cut out one or two nozzles so that the tips touch
• Uniform spray

Calibrating the stone spreader

Calibration

Spreader
• Place yd² canvas on the ground
• Set aggregate application rate on the spreader
• Apply aggregate at operating speed
• Weigh the canvas with the aggregate inside
• Discard aggregate
• Weight the canvas empty
• Subtract the weights and this is your application rate
• Adjust if needed

Reminder:
• Each aggregate application rate must be calibrated by rate, by type, and by quarry
Calibration Distributor
- Determine 100 foot test section
- Record beginning volume
- Set application rate computer
- Apply emulsion
- Record ending volume
- Calculate yd² coverage by multiplying length x width shot
- Divide yd² into gallons used to verify rate
- Adjust application rate accordingly

Reminder:
- Each application rate must be calibrated
- Emulsion application temperature range 160-170°F

End of Session One
Materials

Emulsion

- Emulsions are mixtures of liquid asphalt and water, with additives for stability.
- Durable, long lasting, rapid setting, good aggregate retention.
- Specifications require cationic rapid set emulsion.
- CRS-2L or CRS-2P – proven reduction in loose aggregate.
- Emulsion will have a slightly positive charge.
- Do not mix emulsion grades.
- Bill of Lading – Tanks.
- Application Temperature 160-170°F.

Reminder:

- Keep stockpiles clean and dry.
- Keep aggregate separated.
- Keep base material out of aggregate pile.

Aggregate

- Compatible – anionic.
- Shape – cubical.
- Hardness – granite or slate.
- Cleanliness – minimum fines.
- Uniform size – single or gap graded.
- Surface properties – crushed face.

* Flat tends to bleed.
* Limestone tends to crush under roller or traffic.
*** Dust tends to bleed and ravel.
Next Section: Specification

Specification

Pre-application meeting
- Project Engineer
- Contractor
- Subcontractors
- Area Roadway Engineers
- State Pavement Construction Engineer (Optional)
- Materials and Test Representative (Optional)

Certificate of compatibility
- Emulsion and aggregate
  - Per aggregate
  - Per grade
  - Per quarry
Specification

- Season runs April 1st to Oct 15th
- 50°F and rising air and/or surface temperature
- No paving in rain, fog, or on wet roads
- Remove dust, dirt, and debris from roadway
- Self-propelled aggregate spreader
- Emulsion Grades: CRS-2L and CRS-2P
- Emulsion application temperature 160-170°F
- 100 foot test section – required
- Brooming required 3 to 7 days after Chip Seal Treatment

### TABLE 660-1

<table>
<thead>
<tr>
<th>Type of Coat</th>
<th>Layer</th>
<th>Aggregate Type</th>
<th>Aggregate Target Rate A (Lbs/Sy)</th>
<th>Emulsion Target Rate B,C,D (Gal/Sy)</th>
<th>Temperature (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Seal</td>
<td>Top</td>
<td>#57</td>
<td>12</td>
<td>0.20</td>
<td>160-170</td>
</tr>
<tr>
<td></td>
<td></td>
<td>#67</td>
<td>12</td>
<td>0.20</td>
<td>160-170</td>
</tr>
<tr>
<td></td>
<td></td>
<td>#8</td>
<td>12</td>
<td>0.20</td>
<td>160-170</td>
</tr>
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<td>0.32</td>
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<tr>
<td></td>
<td></td>
<td>#67</td>
<td>30</td>
<td>0.32</td>
<td>160-170</td>
</tr>
<tr>
<td>Triple Seal</td>
<td>Top</td>
<td>#57</td>
<td>12</td>
<td>0.20</td>
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<td>Mat and Single Seal</td>
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Specification

**Tolerances:**
- ± 0.03 gal/yd²
- ± 0.03 t/1000 ft²
- Divisions will include project special provisions:
  - Map numbers
  - Chip Seal type
  - Aggregate type per layer
  - Application rates
Specification
- Rolling 3 complete coverages on each layer (one pneumatic and one steel)
- Within 5 minutes of laydown when using CRS-2L or CRS-2P
- Rolling 3 complete coverages on each layer
- 1 complete coverage by Pneumatic Roller
- 1 complete coverage by Steel Wheel
- 1 complete coverage by either roller
- 1 complete coverage will require 2 or 3 passes depending on width

Specification
Requires a 12 month warranty

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<th>Surface Defects</th>
<th>Severity</th>
<th>Extent (Per Lot)</th>
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<td>Surface Patterns</td>
<td>Alternate lean and heavy lines streaking over the entire pavement surface.</td>
<td>Greater than 20% of the lot affected. Distress spotted evenly over the lot or over localized areas within the lot.</td>
</tr>
<tr>
<td>Bleeding/Flushing</td>
<td>Distinctive appearance with excess asphalt binder already free.</td>
<td>Greater than 20% of the wheel tracks within a bit affected.</td>
</tr>
<tr>
<td>Loss of Cover Aggregate</td>
<td>Large patches of cover aggregate lost from the pavement surface.</td>
<td>Greater than 20% of the lot affected. Distress spotted evenly over the lot or over localized areas within the lot.</td>
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Specification
Pay Item Pay Unit
- Asphalt Surface Treatment, Single Seal Square Yard
- Asphalt Surface Treatment, Double Seal Square Yard
- Asphalt Surface Treatment, Triple Seal Square Yard
- Asphalt Surface Treatment, Mat and Single Seal Square Yard
- Asphalt Surface Treatment, Mat and Double Seal Square Yard
- Asphalt Surface Treatment, Fog Seal Square Yard
- Asphalt Surface Treatment, Sand Seal Square Yard
- Asphalt Surface Treatment, Mat Coat, No. __ Stone Square Yard
- Emulsion for Asphalt Surface Treatment Gallon
Weather

Moisture and Temperature
- Goldilocks and Three Bears
  - Moisture
    - Too much water has the tendency to bleed
    - Too little water has the tendency to ravel
    - A little water on surface aggregate – just right
  - Temperature
    - Extremely high temperatures have the tendency to bleed
    - Extremely low temperatures have the tendency to ravel
    - 70°F and 80°F degrees – just right
- Wind
Traffic Control

- NCDOT contracts include standard
- Contract resurfacing modified for Chip Seals
- Pilot truck required
- Road construction ahead - prepare to stop, flagger ahead, and signs are required in addition to stationary signing during construction
- The AST Spec references the "Temporary Traffic Control (TTC) Special Provisions RWZ-1"

Sequence of Operations (Video)
Triple Seal

Centerline Tie Strip - Longitudinal Joints

Traffic Control

Employee Safety
- Trucks going backwards
- Large and fast moving
- Blind spots
- Intersections
- Power lines
End of Session Three
Issues

- Chip Seals require an "Art," finesse, or experience in placement

Issues typically will revolve around:

- How materials are being used
- How materials are being placed

Remember Goldilocks

- Too much or too little emulsion or aggregate is bad
- Needs to be just right

Four Main Categories

- Excessive emulsion
- Excessive aggregate
- Insufficient emulsion
- Insufficient aggregate

These can be caused by:

- Human error
- Equipment malfunctions
- Materials out of specification
Issues
Excessive emulsion – Bleeding
Causes:
  o Emulsion rate too high
  o Excessive overlap
  o Existing road bleeding before application
  o Dirty aggregate
  • Over use of hand wand
  • Leaks on the distributor – pump, bar, and nozzles
  • Insufficient aggregate applied
  • Improper spray bar height, or nozzle angles

Issues
Insufficient emulsion – Streaking or Raveling
Causes:
  o Cold emulsion
  o Improper spray bar height
  o Improper nozzle angle
  o Emulsion rate too low
  • Worn or clogged nozzles
  • Improper pump speed
  o Distributor values not opening

Issues
Excessive Aggregate, Raveling, and Shelling
Causes:
  • Aggregate rate too high
  • Insufficient or non-uniform emulsion application
  • Excessive overlap or spillage
  o Spreader operator
  o Belt operator
  o Truck drivers
  • Applying aggregate where no emulsion is applied
  • Improper rolling
Issues

Excess Aggregate Piles

Issues

Insufficient Aggregate – Bleeding
Causes:
- Aggregate rate too low
- Dirty aggregate
- Gates stopped up
- Gates not set properly
- Belt operator not supplying front hopper with aggregate
- Poor traffic control – traffic on seal too soon

Issues

Poor Chip Seal
Treatment techniques:
- Construction vehicles whip off aggregate
- Broom too soon
- Failure to raise auxiliary axles on trucks
- Brooming before curing
Issues
Other Issues:
• Timing or sequence of operations – poor workmanship
• Breaking vs curing
• Condition of existing road
  o Cleanliness
  o Seal or repair
• Wash boarding and crack sealing
• Distributor and spreader pulling straight lines – no voids
• Wrong road
• Worn and clogged nozzles

Next Section: Common Practices

Common Practices
• Varying application widths to avoid hand work
• Shooting blind or shooting on your off side
• Sweeping early in the morning 3 to 7 days after Chip Seal Treatment
• blotting sand – bleeding or concrete drives
• Intersection paving – safety, excessive materials
• Stagger loaded dump trucks – behind spreader
• Lift drop axles upon arrival
• Turning around on job – Avoid intersections that were just paved
• Concrete driveway – DO NOT ENTER
• Watch for overhead power lines
  o Belt operator – responsible for keeping dump trucks out of power lines
Next Section: Inspection

Inspection
Areas of Concern Include:
• Condition of existing pavement
• Cleanliness of existing roadway
• Weather
• Proper traffic control
• Temperature of the emulsion
• Qualities of both emulsion and aggregate
• Gallons of emulsion used
• Square yards of aggregate placed
• Rate of materials laydown
• Timeliness of emulsion, aggregate, and rolling

Questions and Checklist
NCDOT Chip Seal Best Practices Checklist
1. Has the Certificate of Compatibility been submitted for each Chip Seal type?
2. Has the existing roadway surface been cleaned and prepared for the Chip Seal?
3. Are weather conditions, air, and surface temperatures sufficient for Chip Seal application?
4. Are traffic control signs in place and is pilot car ready?
5. Have the Bills of Lading for the asphalt emulsion been received?
6. Has the Distributor truck been calibrated for this project?
7. Is the target rate of emulsion for each Chip Seal type known?
8. How will the gallons of emulsion be measured or determined?
9. Is the application temperature of emulsion between 160-170°F?
10. Does the Distributor spray a uniform lift of emulsion?
11. Is spray pattern free from streaks or heavy concentrations of emulsion?
12. Has the Aggregate Spreader been calibrated for this project?
Questions and Checklist

13. Is the target rate of aggregate for each Chip Seal type known?
14. Has Aggregate Spreader been calibrated across the width of the Spreader box?
15. Does the Spreader apply a uniform lift of aggregate?
16. Is the aggregate clean and free from dirt, dust, or debris?
17. Are pulls covering the edge of road and centerline joints completely?
18. Is excess aggregate being removed before additional lifts are being placed?
19. Are the Pneumatic and Steel Wheel Rollers operational?
20. Are Roller coverages completed within 5 minutes of emulsion placement?
21. Is traffic being maintained through the work zone?
22. Are mechanical or other brooms in proper working condition?

Next Section: QA/QC

QA/QC

Certificate of Compatibility – required compliance before Chip Seal Treatment begins

During Construction:
• Asphalt Emulsion Sampling
• Aggregate Sampling
• Handled by materials and test unit in Raleigh 919.329.4000