Guidelines on Variable Asphalt Shot Rates for Seal Coats

TxDOT Project Director: Paul Montgomery

TTI Researchers: Principal Investigator - Paul Krugler, Cindy Estakhri, Carlos Chang
Seal Coat Statistics

- Contracted Seal Coats
  - About 16,000 lane miles per year
- State Force Seal Coats
  - About 3000 lane miles per year
- Average life of a seal coat: ~ 6 to 8 years.
Presentation Overview

- Defining TVAR and Its Value
- Specifications for TVAR
- Where to Use TVAR
- Selecting TVAR Shot Rates
- Inspecting and Calibrating Distributor
Defining TVAR and Its Value
What Is Transverse Variation of Asphalt Rate (TVAR)?

TVAR is the seal coat practice of varying the amount of seal coat asphalt being applied across the width of the pavement to better match the asphalt needs of the existing pavement surface.
Defining TVAR and Its Value
A common misconception is that TVAR reduces the amount of asphalt being placed on the roadway. TVAR actually increases the total amount of asphalt being used if prior practice has been to design the asphalt rate based only on wheel path conditions.
What We Learned from Survey of TxDOT Districts

13 Districts Were Using TVAR as Standard Practice

3 Districts Used TVAR as Standard Practice in the Past but Don’t Anymore

1 District Was Currently Experimenting with TVAR

2 Districts Experimented with TVAR and Decided Not to Use It

8 Districts Reported No Use in Last Five Years
Specifications for TVAR
What About TVAR Specifications?

- No Special Provision to TxDOT Item 316 Is Needed
- Include by Plan Note
- Clarifies Additional Distributor Calibration Procedure
- States that the Engineer Will Determine Where TVAR Will be Used
TVAR Plan Note

- Distributor Must Be Able to Provide at Least One TVAR between 22 and 32 Percent

- Allows Both Common Distributor Types:
  - distributors with dual spray bars and separate computer controllers, and
  - standard distributors where the operator will have to change out nozzles more frequently
Specifications for TVAR

Dual Spray Bar Distributor
Where to Use TVAR
Considering Why and When to Use TVAR

- Wherever asphalt demand varies across the road
- Asphalt type and grade are not factors when considering use of TVAR
- Aggregate type is not a factor
- May be placed on any pavement surface
- But, it’s recommended that districts without experience with TVAR begin with applications over existing seal coats with wheel path flushing
Where to Use TVAR

Selecting Roadway Sections Appropriate for TVAR by Visual Appearance
Severe Flushing
Moderate to Severe Flushing
Moderate Flushing
Mild Flushing
Slight Wheel Path Color Difference
No Wheel Path Color Difference
Situations to Avoid TVAR Use

- With Grade 5 (1/4-in) aggregate
- With emulsions on full super-elevated curves
- On new construction
- On shoulders and other non-traffic locations
- In continuous left-hand turn lanes where traffic patterns are random
- In intersections where the side street also carries considerable traffic volume, and
- On flushed or bleeding hot mix pavements that may have stripping or an otherwise unstable pavement layer below
Selecting TVAR Shot Rates
The design asphalt application rate for each roadway must always be the rate deemed optimal for the wheel paths to hold the new wheel path aggregate without the asphalt later flushing to the surface.
Selecting TVAR Shot Rates

Determining the TVAR Percentage for Outside the Wheel Paths

- TVAR Use with Single Spray Bar Distributors
- TVAR Rates with Dual Spray Bar Distributors
- Texture Testing When Uncertain About TVAR Rate to Use
Selecting TVAR Shot Rates

Sand Patch Test
Selecting TVAR Shot Rates

Measuring Diameter
<table>
<thead>
<tr>
<th>Roadway and Condition</th>
<th>Sand Patch Average Diameters, mm</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wheel Path</td>
<td>Between Wheel Paths</td>
<td>Difference</td>
<td></td>
</tr>
<tr>
<td>Severe Flushing of Grade 3 Seal Coat</td>
<td>199</td>
<td>111</td>
<td></td>
<td>88</td>
</tr>
<tr>
<td>Moderate to Severe Flushing of Grade 3 Seal Coat</td>
<td>200</td>
<td>117</td>
<td></td>
<td>83</td>
</tr>
<tr>
<td>Moderate Flushing of Grade 3 Seal Coat</td>
<td>174</td>
<td>129</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>Mild to Moderate Flushing of Grade 3 Seal Coat</td>
<td>177</td>
<td>129</td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>Mild Flushing of Grade 3 Seal Coat</td>
<td>184</td>
<td>121</td>
<td></td>
<td>63</td>
</tr>
<tr>
<td>Slight Color Difference across Recent Grade 4 Seal Coat</td>
<td>121</td>
<td>99</td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>No Visible Color Difference across Recent Grade 4 Seal Coat</td>
<td>121</td>
<td>112</td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>
### Guidance for Interpreting Sand Patch Test Results

<table>
<thead>
<tr>
<th>Difference in Sand Patch Average Diameters</th>
<th>Asphalt Rate Increase Outside of Wheel Paths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 20 mm</td>
<td>None</td>
</tr>
<tr>
<td>21 to 50 mm</td>
<td>15%</td>
</tr>
<tr>
<td>Greater than 50 mm</td>
<td>30%</td>
</tr>
</tbody>
</table>
Inspection and Calibrating the Distributor
Calibrating and Inspecting the Asphalt Distributor

- Several additional distributor checks which should be done by the contractor and observed by the inspector.
- Selection of nozzles to provide the desired asphalt rate variation is a contractor decision to be verified during the additional distributor calibration run or runs.

Inspection and Adjusting TVAR Shot Rates
### Suggested Nozzle Configurations

<table>
<thead>
<tr>
<th>Lane Width, Feet</th>
<th>Number of Center Line to Wheel Path Nozzles</th>
<th>Number of Inside Wheel Path Nozzles</th>
<th>Number of Between Wheel Path Nozzles</th>
<th>Number of Outside Wheel Path Nozzles</th>
<th>Number of Wheel Path to Pavement Edge Nozzles</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>1</td>
<td>9</td>
<td>6</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>9</td>
<td>6</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>4</td>
<td>9</td>
<td>7</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>5</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>12 (with edge line)</td>
<td>6</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>13</td>
<td>7</td>
<td>9</td>
<td>8</td>
<td>9</td>
<td>6</td>
</tr>
</tbody>
</table>
Setting Computerized Distributor Controls

- Correct determination and entry of the asphalt rate into the distributor’s computer controller is a critical point for inspection.
- Single spray bar and computer.
Inspection and Adjusting TVAR Shot Rates

Formula for Determining Average Shot Rate

Average Rate = \[(L/100) \times (V/100) \times R\] + R

where:

L = % of larger nozzles = (number of larger nozzles/total number of nozzles) \times 100,

V = % increase in asphalt rate selected for outside of the wheel paths, and

R = design rate of asphalt application for the wheel paths in gallons/SY.
Setting Computerized Distributor Controls

- Correct determination and entry of the asphalt rate into the distributor’s computer controller is a critical point for inspection
- Single spray bar and computer
- Dual spray bars and computers
The Contractor Does His Normal Calibration, Plus

Single Bar Distributor - Demonstrate that the Distributor Will Provide a TVAR within the Range of 22% to 32%

Dual Bar Distributor – Recommendation is to Request Demonstration at 15% and 30% TVAR
Inspection and Adjusting TVAR Shot Rates

Determining When Adjusting TVAR is Appropriate
Summary

- TVAR Is a Proven, Successful Technique
- TVAR Provides a Means of Increasing the Design Shot Rate Outside of the Wheel Paths when Wheel Path Flushing Requires a Low Design Rate.
- All Seal Coat Contractors Should Be Able to Provide a TVAR Percentage Between 22% and 32%. 
TVAR May Be Used with both Emulsions and Asphalt Cements

TVAR May be Used with Gr. 3 (1/2-in) and Gr. 4 (3/8-in) Aggregate, Lightweight and Hard Rock, and with Precoated and Plain Aggregate

Design Asphalt Rates Should Always be Selected to Meet Wheel Path Asphalt Needs as Optimally as Possible. This Will Reduce and Sometimes Eliminate Reoccurrence of Wheel Path Flushing.
Summary

- Visual Observation of Wheel Path Flushing Allows Reasonably Good Determination of Need for TVAR.
- Difference in Texture Depth Across the Width of the Pavement Is a Good Indicator of TVAR Desirability
- The Sand Patch Texture Test Can Provide Helpful Information in this Determination, Particularly When the Contractor Is Capable of Adjusting TVAR in Small Increments.
Questions