Quality Control for Modified Asphalt Binders
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Quality Control

Supplier QC

Type of Modification

PMA Production

Loading and Transportation

HMA Plant QC

Offloading/Storage

Production/Construction
## Types of Modification

Example of Modification Applications – Should Be Based on Crude Source, PMA Production Plant

<table>
<thead>
<tr>
<th>Type</th>
<th>Where is the modification added?</th>
<th>Range of Polymer Composition</th>
<th>Parameters of Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBS #1</td>
<td>Production</td>
<td>0-100%</td>
<td>Increase high end PGAB; no effect low temp properties; high molecular weight.</td>
</tr>
<tr>
<td>SBS #2</td>
<td>Production</td>
<td>0-10%</td>
<td>Increases high end PGAB, Lowers Elastic Response; low shear polymer.</td>
</tr>
<tr>
<td>Polyethylene</td>
<td>Production</td>
<td>0-XX%</td>
<td></td>
</tr>
<tr>
<td>PPA</td>
<td>Truck</td>
<td>Typical 0.2-1.5%; 2% Max</td>
<td>Based on Manufacturer Recommendations; not compatible with amine based chemistry</td>
</tr>
<tr>
<td>Process Oil</td>
<td>Production</td>
<td>0-ZZ%</td>
<td>Improves low temperature properties.</td>
</tr>
<tr>
<td>WMA</td>
<td>Truck</td>
<td>0-AA%</td>
<td>Warm mix applications</td>
</tr>
</tbody>
</table>
Types of Modification

Why do we use various modifiers?

- SBS/SBR
- Polyethylene
- Ter-polymers
- Rubber – Ground tire rubber
- Chemical Modification
  - PPA;
  - Process Oils (Ex. Aromatic or Paraffinic Oil)
- Warm Mix Technologies
Types of Modification - PPA

- QC Guidelines for PPA
  - Dosage ratio varies from 0.2 to 1.5%
  - Ratios between 1.5 to 2% - less common
  - PPA modification should be indicated on the Bill of Lading
  - Supplier should provide training to end user to prevent the usage for emulsions and with some warm mix additives (unless a compatible anti-strip or WMA additive is used)
  - Manufacturer recommends PPA and compatible anti-strip/WMA products are added by the supplier to ensure compatibility and certification.
  - Some states recommend limitations on PPA content (Wyoming and Georgia)
Types of Modification - WMA

- According to NAPA’s “Warm Mix Asphalt: Best Practices – 3rd Edition” there are
  - 22 Processes and Products
  - 47 States have specifications for WMA
- [www.neaupg.uconn.edu](http://www.neaupg.uconn.edu)
  - NEAUPG Qualified WMA Technologies
    - 12 Approved Technologies
  - NEAUPG Qualification Process
NEAUPG Qualified WMA Technology – March 2012

- Organic (Waxes) Additives
  - SONNEWARMix™
- Chemical Additives
  - CECABASE RT
  - Evotherm WMA
  - Low Emission Asphalt-Lite (LEA-Lite)
  - Rediset LQ
- Foaming
  - Advera
  - Double Barrel Green System Green Pac for Continuous and Batch Plants
  - Low Emission Asphalt (LEA)
  - MAXAM AQUABlack WMA System
  - Meeker Warm Mix System
  - Terex® Foamed Warm Mix Asphalt System
  - Stansteel Accu-Shear
Northeast States WMA Qualification Process

- Part I – WMA Technology Qualifications/Experience
  - WMA Technology Specific Info; Results and Test Data
  - Experience with WMA
- Part II – Submit Binder and Additive Samples for Sponsor State DOT Testing
  - Binder and Additive Samples, Required Testing
- Part III – Required Mixture Testing on Sponsor State DOT Mix Designs
- Part IV – Submit Technology Specific Production Testing and Compaction Details
- Part V – Approval
  - No Negative Impact to Binder Performance Grade
  - Comparable Mix Properties
WMA Compaction

- WMA Compaction will vary based on the paving conditions and technology
  - Warm weather paving
  - Pave in cool ambient conditions
  - Long haul
  - Higher percentages of RAP

Typically WMA can be produced at temperatures that are 35 to 100°F below traditional HMA temperatures.
Supplier QC - PMA Production

- Laboratory Research and Development
- Polymer Compatible/Stability
- Performance Properties
- Are there limitations of use for a given polymer or chemical modification?
Supplier QC - PMA Production

Laboratory Research and Development

- Polymer Compatible/ Stability
- Performance Properties
- Are there limitations of use for a given polymer or chemical modification?
Polymer Compatibility/Stability

- Temperature of milling
- Tank Storage Temperature
- Polymer loading
- Polymer composition
- Mill Gap
- Base Asphalt Crude Composition Base Asphalt Chemical composition
- Curing time at various polymer percentage levels
- Days of stability
- Tank heel age and composition prior to production runs
# Polymer Compatibility/Stability

<table>
<thead>
<tr>
<th>Polymer Compatibility/Stability</th>
<th>SBS10-10</th>
<th>SBS10-20</th>
<th>SBS10-30</th>
<th>SBS10-40</th>
<th>SBS10-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBS10-10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBS10-20</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>SBS10-30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBS10-40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBS10-50</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PG 70-22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polymer</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
</tr>
<tr>
<td>Sep Test, R + B Diff</td>
<td>0</td>
<td>3.9</td>
<td>2.8</td>
<td>0</td>
<td>-2.2</td>
</tr>
<tr>
<td>% Difference – DSR</td>
<td>-2.2</td>
<td>3.8</td>
<td>4.8</td>
<td>0</td>
<td>-1.5</td>
</tr>
<tr>
<td>ODSR Fail Temp</td>
<td>99</td>
<td>94.9</td>
<td>94.3</td>
<td>97.4</td>
<td>95.9</td>
</tr>
<tr>
<td>RDSR Fail Temp</td>
<td>98</td>
<td>93.0</td>
<td>94.6</td>
<td>95.8</td>
<td>95.1</td>
</tr>
<tr>
<td>PG Classification</td>
<td>PG 94-XX</td>
<td>PG 88-XX</td>
<td>PG 94-XX</td>
<td>PG 94-XX</td>
<td>PG 94-XX</td>
</tr>
<tr>
<td>True Grade</td>
<td>98-XX</td>
<td>93-XX</td>
<td>94.3-XX</td>
<td>95.8-XX</td>
<td>95.1-XX</td>
</tr>
</tbody>
</table>
Supplier QC - PMA Production

- PMA Plant Production Parameters
  - Can the PMA plant process the SBS?
  - Does this SBS help cure times, PGAB properties?
Verifying that the PMA Production is Cured
PMA Storage

What is the storage stability of the modified binder?

What temperature should the binder be stored at?

Does the storage temperature of the PMA affect the PGAB binder properties?
Transportation of PMA to HMA Plant

- Modifier Classification should be provided on the Bill of Lading
- Examples:
  - SBS/Warm Mix Surfactant
  - SBS/PPA Modified
- The trailer should be inspected to be free and clear of contamination
- An example of typical verbiage from a supplier QC plan is below:
  - A statement of this certification, signed by the driver, will be on each shipment/delivery ticket. This statement reads “I certify that this tanker is free of contaminating material upon loading. The product on prior load was ____________.”
## Effects of Trailer Bottoms

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>ROB</th>
<th>Flash, C</th>
<th>ODSR @ 52°C, kPa</th>
<th>Mass Loss, %</th>
<th>Penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROB11-70</td>
<td>0%</td>
<td>254</td>
<td>1.48</td>
<td>-0.360</td>
<td>201</td>
</tr>
<tr>
<td>ROB11-01</td>
<td>0.5% ROB-A</td>
<td>265</td>
<td>1.45</td>
<td>-0.428</td>
<td>207</td>
</tr>
<tr>
<td>ROB11-08</td>
<td>0.5% ROB-B</td>
<td>265</td>
<td>1.38</td>
<td>-0.389</td>
<td>207</td>
</tr>
<tr>
<td>ROB11-15</td>
<td>0.5% ROB-C</td>
<td>257</td>
<td>1.44</td>
<td>-0.368</td>
<td>206</td>
</tr>
<tr>
<td>ROB11-22</td>
<td>0.5% ROB-D</td>
<td>262</td>
<td>1.45</td>
<td>-0.406</td>
<td>207</td>
</tr>
<tr>
<td>ROB11-29</td>
<td>0.5% ROB-E</td>
<td>265</td>
<td>1.38</td>
<td>-0.456</td>
<td>216</td>
</tr>
<tr>
<td><strong>Average @ 0.5% ROB</strong></td>
<td></td>
<td>263</td>
<td>1.42</td>
<td>-0.409</td>
<td>209</td>
</tr>
<tr>
<td><strong>AVG % Change at 0.5% ROB</strong></td>
<td></td>
<td>3.5</td>
<td>-4</td>
<td>13.7</td>
<td>3.8</td>
</tr>
<tr>
<td>ROB11-50</td>
<td>1% ROB-A</td>
<td>257</td>
<td>1.34</td>
<td>-0.564</td>
<td>216</td>
</tr>
<tr>
<td><strong>% Change at 1.0% ROB</strong></td>
<td></td>
<td>1.2</td>
<td>-9.4</td>
<td>56.7</td>
<td>7.5</td>
</tr>
<tr>
<td>ROB11-60</td>
<td>2% ROB-A</td>
<td>251</td>
<td>1.21</td>
<td>-0.770</td>
<td>230</td>
</tr>
<tr>
<td><strong>% Change at 2.0% ROB</strong></td>
<td></td>
<td>-1.2</td>
<td>-18.2</td>
<td>114</td>
<td>14.4</td>
</tr>
</tbody>
</table>
QC at HMA Plant

- Establishing and checking the receiving tank
- Tank Storage Specifications
- Product Loading Guidelines
QC at HMA Plant

- Tank Storage Specifications
- Tank Model Number
- Orientation
- Height
- Heating Type
- Nominal Volume
- Gross Volume, gal
- Gross Volume, gal/inch
- Coil Displacement Volume
- Reserved Space Volume
- Net Volume, gal
- Net Volume, gal/inch
Percent Reduction in ODSR Values at Various Levels of Co-mingling
Results of Co-mingling

- PG 82-22: approximately for every 10% contamination with PG 64-22 the ODSR values will be reduced by 3-6%, and the RDSR values would be reduced 2 to 3%.

- PG 76-22: approximately for every 10% contamination with PG 64-22 the ODSR and RDSR values will be reduced by 1 to 2%.

- PG 64-28: approximately for each 10% contamination with PG 58-28 the ODSR values will be reduced by 1 to 3%, and the RDSR values will be reduced by 1 to 4%.
# Results of Co-mingling

<table>
<thead>
<tr>
<th>Base PG Grade</th>
<th>Base PG Grade (PG Grade w/ % Let Down)</th>
<th>High Temp. True Grade</th>
<th>ODSR @ 82°C, kPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG 82-22</td>
<td>PG 82-22</td>
<td>90.09</td>
<td>1.89</td>
</tr>
<tr>
<td></td>
<td>PG 82-22 (10% PG64-22)</td>
<td>84.99</td>
<td>1.28</td>
</tr>
<tr>
<td></td>
<td>PG 82-22 (20% PG64-22)</td>
<td>82.69</td>
<td>1.06</td>
</tr>
<tr>
<td></td>
<td>PG 82-22 (30% PG64-22)</td>
<td>80.67</td>
<td>0.891</td>
</tr>
</tbody>
</table>
### QC at HMA Plant

#### Example Loading Guidelines

<table>
<thead>
<tr>
<th>Last Product in Tank</th>
<th>Product to be Loaded</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PG 58-28</strong></td>
<td><strong>PG 64-22</strong></td>
</tr>
<tr>
<td>OK to Load</td>
<td>Drain to Min. Level</td>
</tr>
<tr>
<td>Drain to Min. Level</td>
<td>OK to Load</td>
</tr>
<tr>
<td>Drain to Min. Level</td>
<td>Drain to Min. Level</td>
</tr>
<tr>
<td>Empty to no measurable quantity</td>
<td>Empty to no measurable quantity</td>
</tr>
</tbody>
</table>
Questions?