Automated Extraction of Asphalt Binder

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Asphalt Binder Expert Task Group
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• WHRP
Outline

• Equipment Overview
• Binder Percent
• Aggregate Gradation
• Instrument Verification
• WHRP Study
• Ruggedness Study
• ASTM ILS
• AASHTO re:source PSP Data
Automated Extraction System

1= Washing chamber  
2= Washing chamber heating system  
3= Inspection window  
4= Centrifuge  
5= Centrifuge motor  
6= Condenser  
7= Pump  
8= Outlet valve  
9= Solvent pump  
10= Integrated cooling system  
11= Dirty solvent tank  
12= Distillation unit heating system  
13= Clean solvent tank
Automated Extraction System
Internal Evaluation
Binder Extraction – AASHTO T164

*Reflux Extraction did not include a mineral matter determination.
**Error bars are based on AASHTO T164 d2s
Figure 1. Comparison of Extraction Method Results on Eight RAP Samples

\[ y = 0.9867x \]

\[ R^2 = 0.9909 \]
AASHTO re:source PSP
Binder Extraction

**Error bars are based on PSP d2s**
Internal Evaluation
Gradations – AASHTO R30

*Reflux Extraction did not include a mineral matter determination.
**Error bars are based on ASSHTO R30 d2s.
AASHTO re:source PSP
Gradation

**Error bars are based on PSP d2s**
AASHTO re:source PSP
Gradation

% Passing Sieve

1/2" 3/8" #4 #8 #16 #30 #50 #100 #200

85 AASHTO 85 Lab 1 86 AASHTO 86 Lab 1

**Error bars are based on PSP d2s**
Instrument Verification
Repeatability – AASHTO T164

**Error bars are based on AASHTO T164 d2s**
Instrument Verification

Repeatability

**Error bars are based on AASHTO R30 d2s**
• Ignition Oven
• Centrifuge Extraction
• Reflux Extraction
• Automated Extraction System
Ruggedness Study

- Collaboration with ASTM ILS
- Using Reflux Method as Control
- Evaluating Percent Binder and Aggregate Gradation

<table>
<thead>
<tr>
<th>Factor</th>
<th>Factor Name</th>
<th>Low -</th>
<th>High +</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Binder Type (depends on G)</td>
<td>64-22 or 52-34</td>
<td>64-22E or 52-34E</td>
</tr>
<tr>
<td>B</td>
<td>Aggregate Absorption</td>
<td>0.75</td>
<td>2.0</td>
</tr>
<tr>
<td>C</td>
<td>% Fines</td>
<td>3 to 5%</td>
<td>10%</td>
</tr>
<tr>
<td>D</td>
<td>Sample Size (g)</td>
<td>1000</td>
<td>2000</td>
</tr>
<tr>
<td>E</td>
<td>% Recycled RAP</td>
<td>0%</td>
<td>45%</td>
</tr>
<tr>
<td>F</td>
<td>% Recycled RAS</td>
<td>0%</td>
<td>5%</td>
</tr>
<tr>
<td>G</td>
<td>Low PG Grade</td>
<td>-34</td>
<td>-22</td>
</tr>
</tbody>
</table>
ASTM ILS

- Solvent pH and Alkalinity
- Aggregate Drying
- Percent Fines in Binder Solution
- Percent Binder
- Aggregate Gradation
- PG Grading of Recovered Binder