COLD IN-PLACE RECYCLING UTILIZING ENGINEERED EMULSION: PROJECT SELECTION AND CONSTRUCTION PRACTICES

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MATERIALS

- Engineered Emulsion (approx. 3%)
- Lime or cement (approx. 1%, used as a mineral filler and curing aid)
- Water (approx. 1%)
- Recycled asphalt pavement

- Fog Seal (application rate 0.05 to 0.15 gal/sqyd)
- Blotter
ASPHALT RECYCLING METHODS

• Cold In-Place Recycling (C-I-R)
  • Milling
  • Re-mixing
  • Placing and compacting
  • Same day operation

• Central Plant Recycling
  • Milling and removal
  • Line and grade adjustments
  • Central plant mixing
  • Hauling, placing and compacting
C-I-R PROCESS
ASPHALT RECYCLING METHODS

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CENTRAL PLANT RECYCLING
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- Requires a lot of storage space
- Multiple handling operations
CENTRAL PLANT RECYCLING
LAYDOWN PROCESS
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- C-I-R: Leave thin section of existing asphalt in place
  - Provides support for the milling train
  - Uniform material
LAYDOWN PROCESS

- Utilize pickup machines or
- End dumps directly into the paver
LAYDOWN PROCESS

- Material uniformly coated with emulsion
- Reduce down to 1.5 inch minus
LAYDOWN PROCESS
LAYDOWN PROCESS

- Allow material to begin cure prior to compaction
- Climate will adjust cure time
  - Shaded
  - High humidity
  - Temperature
- Emulsion supplier can provide cure accelerant
LAYDOWN PROCESS

• Keep rollers back from paver
• Rapid compaction prevents efficient curing
LAYDOWN PROCESS
LAYDOWN PROCESS

- Initial breakdown with smooth vibratory double drum
- Pneumatic as Intermediate
- Finish with smooth drum to remove roller marks
FINAL SURFACE: PRIOR TO FOG

- Micro cracking is acceptable
- Traffic will aid in kneading together
LAYDOWN PROCESS

- When to fog
  - Product stability
- Using blotter
- Traffic control and timing
LAYDOWN PROCESS

• Fogged surface vs. open surface
• Cure times - minimum two hours after compaction
CONSTRUCTION INSPECTION

- Monitor cutting depth / milling operation
- Do not include any base material (C-I-R)
- Emulsified asphalt addition rate (approx. 3%)
  - Established at start as part of mix design
  - Adjustments may be necessary
  - Mix will look dry
- Lime or cement addition rate (1%)
- Pavement laydown – placement depth and width
- Compaction (Don’t rush it!)
- Fog coat and blotter application
CHALLENGES: RUTTING
CHALLENGES: RAVELING
PROJECT SELECTION
PROJECT SELECTION

- Estimated at approx. ¾ strength of HMA
- Provides opportunity to reuse existing materials
- Reduces pavement structure
- C-I-R needs reasonably consistent pavement depth. Approx ½” depth more than design
  - Do not include aggregate base with layer
PROJECT SELECTION:
C-I-R OR CENTRAL PLANT RECYCLING

• Boring logs with depths of layers from subsurface investigation
• Project constraints / considerations
  • Adjusting grade
  • Sound existing structure with old pavement
  • Room for overlay
  • Excessive sub-excavation required
• Structural pavement analysis
• Sustainability concept
PROJECT SELECTION: ESTIMATION OF QUANTITIES

- In-place hot mix asphalt pavement = 150 pounds per cubic foot
  - In-place air voids approx. 5%
- C-I-R pavement = 135 pound per cubic foot
  - In-place air voids approx. 14%
  - No handling loss
- Central plant mixed
  - In-place air voids approx. 14%
  - Assume 5 to 10% handling and floor loss
- Approximately 10% increase in volume
PROJECT SELECTION

- Good candidate
- End of service life
- Minor patching
- Fatigue cracking
- 3 inch depth minimum
PROJECT SELECTION

• Poor candidate
  • Consistent recent crack seal
  • Less than 3 inches
  • Need to tie in to existing structures (C-I-R)
### PROJECT SELECTION: BORING LOG EXAMPLE

<table>
<thead>
<tr>
<th>FEDERAL HIGHWAY ADMINISTRATION</th>
<th>6 in H-S AUGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>VANCOUVER, WASHINGTON</td>
<td>DRILL: Unknown</td>
</tr>
<tr>
<td>GEOTECHNICAL SECTION</td>
<td>DRiller: Unknown</td>
</tr>
<tr>
<td>BORING LOG (English Units)</td>
<td>WEATHER: Heavy snow</td>
</tr>
</tbody>
</table>

#### DESCRIPTION

<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>GRAPHIC LOG</th>
<th>SAMPLE #</th>
<th>SAMPLE</th>
<th>BLOW COUNTER</th>
<th>WATER CONTENT (%)</th>
<th>PLASTIC LIMIT</th>
<th>LIQUID LIMIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Asphalt</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td>Red to gray, silty fine to coarse SAND, some fine to coarse gravel, some clay, subangular to angular fragments, damp (SM) (BASE).</td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>Red, fine to coarse GRAVEL, some fine to coarse sand, little silt, trace cobbles, subangular to angular fragments, damp (GP-GM). Hard drilling.</td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>Laboratory testing completed. Laboratory Control Number: W-08-0284-SO 42.4% Gravel, 47.3% Sand, 10.3% Silt GP-GM; Poorly graded gravel with silt and sand. Moisture at R Value is 131.6% at 300 psi. Boring completed at 3 feet.</td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### BORING LOG EXAMPLE

- **Latitude (Degrees):** 48.67487800
- **Longitude (Degrees):** -113.60747500

**Notes:**
- **BEGAN:** 9/15/03
- **COMPLETED:** 9/15/03
- **Drill:** Unknown
- **DRILLER:** Unknown
## Project Selection: Boring Log Data

### Average Distance between Borings
- 2674 feet

### Average Thickness of Pavement
- 6 inches

### Controlling Thickness
- 3.6 inches

### Boring Log Data

<table>
<thead>
<tr>
<th>Boring No.</th>
<th>Station</th>
<th>Distance Between Borings (ft)</th>
<th>Pavement Depth (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG 03-37</td>
<td>1846+20</td>
<td>2580</td>
<td>6</td>
</tr>
<tr>
<td>SG 03-38</td>
<td>1872+00</td>
<td>2780</td>
<td>9.6</td>
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<tr>
<td>SG 03-39</td>
<td>1899+80</td>
<td>2590</td>
<td>8.4</td>
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<tr>
<td>SG 03-40</td>
<td>1925+70</td>
<td>2680</td>
<td>6</td>
</tr>
<tr>
<td>SG 03-41</td>
<td>1952+50</td>
<td>2680</td>
<td>6</td>
</tr>
<tr>
<td>SG 03-42</td>
<td>1979+30</td>
<td>2700</td>
<td>6</td>
</tr>
<tr>
<td>SG 03-43</td>
<td>2006+30</td>
<td>2655</td>
<td>7.2</td>
</tr>
<tr>
<td>SG 03-44</td>
<td>2032+85</td>
<td>2685</td>
<td>6</td>
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</tbody>
</table>

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<th>Pavement Depth (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG 03-45</td>
<td>2059+70</td>
<td>2640</td>
<td>6</td>
</tr>
<tr>
<td>SG 03-46</td>
<td>2086+10</td>
<td>2700</td>
<td>6</td>
</tr>
<tr>
<td>SG 03-47</td>
<td>2113+10</td>
<td>2640</td>
<td>3.6</td>
</tr>
<tr>
<td>SG 03-48</td>
<td>2139+50</td>
<td>2680</td>
<td>7.2</td>
</tr>
<tr>
<td>SG 03-49</td>
<td>2166+30</td>
<td>2676</td>
<td>7.2</td>
</tr>
<tr>
<td>SG 03-50</td>
<td>2193+06</td>
<td>2680</td>
<td>3.6</td>
</tr>
<tr>
<td>SG 03-51</td>
<td>2219+86</td>
<td>2654</td>
<td>6</td>
</tr>
<tr>
<td>SG 03-52</td>
<td>2246+40</td>
<td>2760</td>
<td>4.8</td>
</tr>
<tr>
<td>SG 03-53</td>
<td>2274+00</td>
<td>2680</td>
<td>6</td>
</tr>
</tbody>
</table>
PROJECT SELECTION:
TYPICAL SECTION

Superpave pavement, ½” or ¾” nominal maximum size aggregate, 0.3 to <3 million ESAL, type III pavement roughness, 3” compacted depth (place in 2 equal lifts)

Existing edge of pavement

Cold recycled asphalt base course, 3” compacted depth

Recycled aggregate base, 6” compacted depth

Mill and remove existing pavement to a depth of 3” according to Section 413

Pulverize remaining existing pavement in place to a depth of 6” according to Section 310
CONCLUSIONS

• Utilizes existing materials
• Can be done in place or offsite
• Provides a flexible pavement layer
• Reduces pavement distress
• Decreases pavement structure thickness
THANK YOU!

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