Eight Year Performance of a Recycled Freeway Surface in Ontario

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Presentation Outline

- Background
- Pre-Construction Conditions
- Construction of Trial Sections
- Evaluation of Trial Sections
- Findings
- Summary
- Concluding Remarks
Background...

- MTO has used reclaimed asphalt pavement (RAP) in HMA pavements since 1970’s
- Policy restricted RAP from surface course on heavily trafficked roads to reduce risks associated with its’ use
- MTO supports a “zero waste” approach and in late 1990’s implemented a pavement recycling program to provide sustainable rehabilitation options
…Background

- Project proposed to find cost effective rehabilitation strategies to address early deterioration of DFC mixes on MTO highways

- Strategies included:
  - HIR
  - RHM surface course
  - Microsurfacing
Pre-Construction Conditions…

Hwy 401 Recycling Trials, 1999
...Pre-Construction Conditions

- Road Radar survey found 340 mm HMA over 910 mm granular material
- Material Properties better than usual

<table>
<thead>
<tr>
<th>Property</th>
<th>WB Section Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compaction</td>
<td>96 %</td>
</tr>
<tr>
<td>Air Voids</td>
<td>3.8 %</td>
</tr>
<tr>
<td>Asphalt Cement</td>
<td>5.1 %</td>
</tr>
</tbody>
</table>
Construction of Trial Sections

Hwy 401 WBLs

<table>
<thead>
<tr>
<th>Recycled DFC</th>
<th>Martec HIR</th>
<th>New DFC</th>
<th>Taisei HIR</th>
</tr>
</thead>
</table>

Hwy 401 EBLs

<table>
<thead>
<tr>
<th>Microsurfacing 2000</th>
<th>Microsurfacing 1999</th>
</tr>
</thead>
</table>

Hwy 19  Oxford Rd 6  Hwy 401 EBLs  Sweaburg Rd
### Material Properties After Construction

<table>
<thead>
<tr>
<th></th>
<th>Taisei Rotec HIR</th>
<th>New DFC</th>
<th>Martec HIR</th>
<th>RHM DFC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compaction %</td>
<td>95</td>
<td>93</td>
<td>91</td>
<td>92</td>
</tr>
<tr>
<td>Air Voids %</td>
<td>3.8</td>
<td>3.7</td>
<td>3.8</td>
<td>3.2</td>
</tr>
<tr>
<td>A. C. Content %</td>
<td>4.7</td>
<td>5.2</td>
<td>4.8</td>
<td>5.1</td>
</tr>
</tbody>
</table>
Construction Conditions & Observations…

- Taisei Rotec Section:
  - 0.44 L/m$^3$ rejuvenating oil & 15 mm HMA (PG 58-28 & diabase agg)
  - Paved at 26°C to 18°C
  - Distresses included:
    - moderate midlane segregation throughout
    - Intermittent slight segregation along longitudinal joint
New DFC:

- Milled 55 mm and resurfaced with 54 mm
- PG 64-28 and meta-arkose agg
- Paved at 20°C to 12°C
- Distresses noted:
  - moderate to severe segregation throughout
  - coarse aggregate loss
  - poor longitudinal joint construction
…Construction Conditions & Observations…

- **Martec HIR:**
  - Material removed in two stages
  - 0.43 L/m³ rejuvenating oil & 10 mm HMA (PG 58-28 & meta-arkose agg)
  - Paved at 24°C to 13°C
  - Distresses included:
    - Isolated areas of moderate segregation
    - Slight segregation along longitudinal joint
…Construction Conditions & Observations…

- **Recycled DFC:**
  - Milled 59 mm and placed 52 mm RHM DFC
  - 30 % RAP, 70 % new meta-arkose aggregate with PG 58-28
  - Paved at 16°C to 12°C
  - Distresses included:
    - intermittent moderate end-load segregation
    - L2 and L3 longitudinal joint was poor
Lane 3 Microsurfacing:

- Placed at 16°C to 10°C
- Slow curing process kept lane closed till late afternoon.
- Distresses included
  - Streaks & gouges from dragged oversize agg
  - Rich transverse joints
  - Coarse texture resulted in a noisier ride
Lane 2 Microsurfacing:

- Delayed, placed following year
- Distresses included:
  - Poor transverse joints
  - 50 mm double groove in centre of Lane 2
Year 8 Evaluation of Trial Sections…

- **Roughness** (IRI ~1)– reflect bumps associated with patches
- **Rutting** (~4 mm)– very slight
- **Pavement Friction** (>40)– reflective of high quality agg’s used

- **Visual Observations**
  - Distortions throughout
  - ...

Findings – Taisei Rotec HIR
Findings – New DFC
Findings – Martec HIR
Findings – RHM DFC
Findings – L3 Microsurfacing
Findings – L2 Microsurfacing
Summary…

Microsurfacing Sections

• Did not meet their 5 to 7 year life expectancy

• MTO now routinely tack coats surfaces prior to microsurfacing

• Not expected to hold a dry and ravelling pavement for more than a few years
…Summary…

Recycling Sections...

- Martec HIR provided best initial performance. Recently ravelling & cracking has increased. Expect 9 to 10 yr life.

- RHM DFC similar long term performance. Expect 9 to 10 yr life.

- New DFC’s un-repaired end-load segregation shortened life expectancy - 7 to 8 years.

- Taisei Rotec HIR’s material segregation defects & scallops provide an expected 7 to 8 yr life.
...Summary...

...Recycling Sections

- HIR longitudinal joints performing better than DFC & RHM DFC joints.

- Recycled mixes can meet same ERS requirements as conventional new HMA.

- Although sections do not meet 12 yr expected life for new overlay, found properly constructed RHM can perform equal to new HMA.
Concluding Remarks…

- HIR & central plant recycling are:
  - Cost effective
  - Environmental friendly rehabilitation options
  - Re-use existing non-renewable resources
  - Minimize use of new material
  - Reduce transportation of construction materials
  - Lower GHG emissions
...Concluding Remarks

- MTO is committed to increased recycling
  - Helps address our emission reduction commitments
  - Refines our highway rehabilitation strategies to achieve zero waste

- MTO has and will continue to protect the environment by promoting & implementing innovative pavement recycling techniques such as HIR and central plant recycling.
Thank you!
Questions?

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