AMIR / TRAK Asphalt Compactor
MTO Field Trials 2012-2019

Frank Pinder, Area Contracts Engineer
MTO, Eastern Region
AMIR – Early Trials 2012

- 1st Research Project with Carleton University to tune-up the roller and complete initial field trials;
  - Contractor Yard, Welland – June 1, 15, 2012;
  - Hwy. 60, Wilno – July 2012;
  - Thousand Islands Parkway – Aug. 2012;
- Persistent equipment challenges and incomplete trials.
AMIR – Hwy. 28 Apsley, Sept. 2012

- RW Tomlinson became involved;
- 1st complete and successful trial;
- Superpave 12.5FC1 ("Fine-graded" as per MTO std.)
AMIR – Hwy. 28 Apsley, Sept. 2012

Excellent Texture:
• After first roller pass, texture is tight;
• Uniform appearance in all directions
AMIR – Hwy. 28 Apsley:

Acceptable Compaction: compaction evident; each roller pass was (visually) compressing the mat;
AMIR – Hwy. 28 Apsley, Sept. 2012

Lower permeability = Longer Life?

<table>
<thead>
<tr>
<th>Sample Location</th>
<th>Steel Roller (cm/s X 1000)</th>
<th>AMIR Roller (cm/s X 1000)</th>
<th>Factor of Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midlane</td>
<td>1.16</td>
<td>0.58</td>
<td>2.0</td>
</tr>
<tr>
<td>Centerline Edges</td>
<td>6.20</td>
<td>1.53</td>
<td>4.1</td>
</tr>
<tr>
<td>Outside Edges</td>
<td>3.42</td>
<td>1.31</td>
<td>2.6</td>
</tr>
<tr>
<td>Unrestrained Edges</td>
<td>3.90</td>
<td>1.19</td>
<td>3.3</td>
</tr>
<tr>
<td>Ave. All</td>
<td>3.59</td>
<td>1.11</td>
<td>3.2</td>
</tr>
</tbody>
</table>
AMIR – Focus on Bridge Deck Paving
2014-15:

Opportunity:
- Bridge deck paving critical for protection of the bridge deck waterproofing system;
- But challenging to get quality compaction on bridge decks…
  → Tricky placing and compacting 1st 40mmn lift on waterproofing layer;
  → No vibration permitted
- 25 year service life for waterproofing system before R&R required;
  • Can we do better?
AMIR – Hwy. 417 Underpass at Hwy. 34

Details:
- Superpave 12.5 FC1, Cat. D;
- AMIR:
  - placed Nov. 27, 2014
  - Ambient Temperature -1°C;
  - 1 - 80mm lift;
- Conventional:
  - Placed in Aug. 2014;
  - 1 – 40mm lift;

<table>
<thead>
<tr>
<th>Hwy. 417 UP at Hwy. 34</th>
<th>Compaction Method</th>
<th>Permeability (cm/s)</th>
<th>Compaction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>6.4 x 10^-3</td>
<td>?</td>
<td></td>
</tr>
<tr>
<td>AMIR</td>
<td>2.0 x 10^-3</td>
<td>92.6</td>
<td></td>
</tr>
</tbody>
</table>
AMIR – Hwy. 417 Underpass at Hwy. 34

July 2019 - after 4.5 years…
- conventional exhibiting moderate coarse aggregate loss;
- AMIR exhibiting very slight, coarse aggregate loss;
AMIR – Hwy. 520 Distress River Bridge

Details:
• Superpave 12.5 Cat. D, Warm Mix Asphalt;
• Placed Dec. 7, 2015
• Ambient Temperature 4°C;
• AMIR 1 – 80mm lift;
• Conventional 1 – 40mm lift;

<table>
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<tr>
<th>Compaction Method</th>
<th>Permeability (cm/s)</th>
<th>Core SG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>$5.6 \times 10^{-3}$</td>
<td>2.352</td>
</tr>
<tr>
<td>AMIR</td>
<td>$2.1 \times 10^{-3}$</td>
<td>2.368</td>
</tr>
</tbody>
</table>
AMIR – Hwy. 520 Distress River Bridge

After 3.5 years…
• conventional exhibiting moderate, frequent, coarse aggregate loss;
• AMIR exhibiting very slight, few, coarse aggregate loss;

AMIR July 2019
Conventional July 2019

AMIR
Conventional

Oct. 2017
AMIR – Hwy. 401 UP at Holt Rd.

Details:
• Superpave 12.5 FC2
• Placed Sept. 17, 2015
• AMIR: 1 – 80mm lift;
• Conventional: 2 – 40mm lifts;
AMIR – Hwy. 401 UP at Holt Rd.

AMIR Mechanical Issues:
- Roller hydraulic leak;
- Belt damage;
- Belt slippage

Not the best product…
AMIR – Hwy. 401 UP at Holt Rd.

Results:
- Asphalt mix had rejectable high air voids… but left in place to preserve test section;
- MTV tore waterproofing on conventional side, had to be patched

<table>
<thead>
<tr>
<th>Compaction Method</th>
<th>Permeability (cm/s)</th>
<th>Core SG</th>
<th>ITS (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>$14.4 \times 10^{-3}$</td>
<td>2.324</td>
<td>453</td>
</tr>
<tr>
<td>AMIR</td>
<td>$4.1 \times 10^{-3}$</td>
<td>2.377</td>
<td>768</td>
</tr>
</tbody>
</table>
Hwy. 417 Underpass at March Rd. – Oct. 2016

- TRAK development; 1\textsuperscript{st} MTO contract;
- Superpave 12.5FC2 Category D;
- Roller mass vs surface contact area critical for AMIR technology;
- Uneven contact pressure with road surface;
- Excellent texture and permeability;
- Ave. Permeability 0.938E-3 cm/s
Objectives:
1. Compare best available asphalt compaction technologies;
   → AMIR II + TRAK;
   → Vibratory + Pneumatic;
   → HAMM Oscillatory + Pneumatic;
Objectives:
2. Determine What Permeability is Achievable;
   → Superpave 12.5 FC2, Category D, Fine-graded, Single lift (50mm)
     and double (2 x 50mm) lift resurfacing;
   → Cold temp, high approx. 1°C
3. Evaluate Carleton University’s (electronic) permeability test equipment
# Didsbury Rd. Ottawa – Nov. 17, 2017

**Results:**

<table>
<thead>
<tr>
<th>Compaction Method</th>
<th>Permeability (cm/s)</th>
<th>Compaction (%)&lt;sup&gt;(1)&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRAK + AMIR</td>
<td>$0.9 \times 10^{-3}$</td>
<td>92.1</td>
</tr>
<tr>
<td>HAMM + Pneumatic</td>
<td>$4.0 \times 10^{-3}$</td>
<td>91.1</td>
</tr>
<tr>
<td>Vib. + Pneumatic</td>
<td>$3.8 \times 10^{-3}$</td>
<td>91.0</td>
</tr>
</tbody>
</table>

Note 1: Mix Voids were high, Ave. 5.2%

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Vibratory check cracking

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![Image of road surfaces with labels: HAMM + Pneumatic, AMIR / TRAK]
Didsbury Rd. Ottawa – 2 Years Later…

August 2019

HAMM + Pneumatic

AMIR / TRAK
Hwy. 401 UP at LaRue Mills – Nov. 12, 2018

Details:
• Superpave 12.5, Category C;
• 1-80mm lift; high 7°C
• Contractor opted-in to new MTO permeability incentive specification
### Hwy. 401 UP at LaRue Mills – Nov. 12, 2018

<table>
<thead>
<tr>
<th>Compaction Method</th>
<th>Field Permeability (cm/s)</th>
<th>Lab Permeability @ 8% AV (cm/s)</th>
<th>QA Compaction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRAK</td>
<td>$3.17 \times 10^{-3}$</td>
<td>$1.95 \times 10^{-3}$</td>
<td>Core 1: 92.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Core 2: 89.9</td>
</tr>
</tbody>
</table>
General Experience from 7 Years of Field Trials:

Technological Development - Credits:

- Evolution of AMIR compactors and their use in trials has been an adventure, with several setbacks and lessons learned;
- Early contributions from Miller Paving and Cruickshank Construction were critical to get the project rolling;
- Involvement and dedication by Russ Perry and RW Tomlinson staff over the past 5 years has enabled the TRAK to be developed in a way that respects the theories proven by Professor Halim;

AMIR / TRAK compactors:

- achieve similar density to conventional compactors, in fewer (generally 6 to 8) passes;
- have a lower compaction temperature requirement (110°C +/-) compared to conventional (145°C +/-);
- can compact thicker lifts of asphalt (up to 100mm) at lower ambient temperatures.
General Experience from 7 Years of Field Trials:

Asphalt compacted with the AMIR / TRAK compactors:
• is free from check-cracking, irrespective of asphalt mix design or compaction temperatures;
• has a 3 times (+/-) lower field surface permeability compared to asphalt compacted conventionally to a similar density;
• has an improved surface texture, with higher initial friction;
• is proving to be more durable over time, with less aggregate loss and less ravelling... supporting the vast amount of literature that indicates lower field permeability correlates to long term performance and durability.

The AMIR / TRAK compactors have evolved and improved substantially. This is expected to continue as MTO considers additional and potentially larger-scale projects.
That’s all - Thank-you!

Hwy. 401 UP at LaRue Mills
Compacted with TRAK Roller
November 2018