Recycled Materials In Transportation Infrastructure

C-TEP/APWA
Western Canada Pavement Workshop
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City of Edmonton - Transportation Services
CONTRACTOR’S ENVIRONMENTAL RESPONSIBILITIES PACKAGE:

CONSTRUCTION AND MAINTENANCE ACTIVITIES

February, 2012
7.10 Hazardous Materials Management, Waste Management and Recycling

Hazardous Materials including hazardous waste shall be managed in accordance with applicable regulations such as the Alberta Fire Code, Waste Control Regulation, Transportation of Dangerous Goods Legislation and Best Management Practices. It is your responsibility to know and adhere to the regulatory requirements that apply to your work. Contractors are responsible for ensuring waste material is disposed at an approved area or facility in accordance with the law.

Hazardous waste manifest or recycle dockets must be completed and appropriate copies maintained on site or by the generator when disposing hazardous waste or hazardous recyclables.

The City of Edmonton requires Contractors to reduce and divert waste from landfills through recycling. At a minimum, contractors shall recycle and segregate cardboard, wood, asphalt, concrete, drywall, metal and general office material. Bins or loads going to Cloverbar landfill for recycling must be at least 75% segregated.

Contractors are responsible for ensuring litter control at their worksites.
Technologies/ Processes Utilized By The City of Edmonton

- Use of Recycled Concrete and Asphalt as Granular Materials in Roadways;
- Use of Recycled Street Sand in Winter as a Traction Aid;
- Use of Recycled Tires in Hot Mix Asphalt and as Aggregate in Embankment Fills;
- Use of Asphalt Millings and Roofing Shingle Tabs and Tear-offs in Hot Mix Asphalt;
- Use of Full Depth Recycling with the Use of Stabilizers;
- Use of Cold-In-Place Recycling;
Concrete / Asphalt Recycling
Crush Material
Stockpile
The City of Edmonton Recycles 200,000 – 220,000 tonnes of Concrete, Asphalt and Granular Materials at 3 processing locations.
Current Aggregate Recycling Locations

184 STREET, 18403 St - 109 Ave

~50 STREET, South of Hwy 37

17 STREET, 53 Ave
Recycled Aggregate Evaluation Project

111 Avenue, 186 Street to Anthony Henday Drive
Purpose And Protocol

- Evaluate recycled aggregate base as compared to natural aggregate base.

- 5 - 150 meter long test sections.

- Pre-testing was carried out on the subgrade materials, including:
  - Soil Classification
  - Atterberg Limits
  - CBR
  - Moisture Content

- Stabilized subgrade with cement.

- Granular Base was placed and compacted in two lifts.

- An asphalt base course was followed by two surface courses of Hot Mix Asphalt
Test Section #1 - (Corrected to 20°C) - All Years

Westbound

<table>
<thead>
<tr>
<th>Station</th>
<th>Deflection (mils)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1+370</td>
<td></td>
</tr>
<tr>
<td>1+380</td>
<td></td>
</tr>
<tr>
<td>1+390</td>
<td></td>
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<tr>
<td>1+400</td>
<td></td>
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<tr>
<td>1+410</td>
<td></td>
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<tr>
<td>1+420</td>
<td></td>
</tr>
<tr>
<td>1+430</td>
<td></td>
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<tr>
<td>1+440</td>
<td></td>
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<tr>
<td>1+450</td>
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<td>1+460</td>
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<td>1+510</td>
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</tr>
<tr>
<td>1+520</td>
<td></td>
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<tr>
<td>1+530</td>
<td></td>
</tr>
</tbody>
</table>
Findings:

- Reclaim 63mm aggregate performed better than the Natural 63mm aggregate.

- Reclaim 63mm aggregate performed better than the Natural 20mm aggregate.

- Section constructed with the Biaxial Geogrid and reduced aggregate section performed as well as the reclaim 63mm aggregate section.
The City of Edmonton Winter Street Sand Recycling Program
Street Sand Recycling

- The City of Edmonton recycles 100,000 – 150,000 tonnes of Street Sweeping materials at 3 processing locations.
Wet Process

- The wet processing concept implemented, combined various technologies developed by the aggregate, concrete and petrochemical industries.

- The four-phase process:
  
  Phase 1 – Waste Removal
  
  Phase 2 – Material Washing
  
  Phase 3 – Fines Processing
  
  Phase 4 – Clean Sand Dewatering and Drying
Street Sand
Recovered from
Street Sweeping

Sand Feed Hopper and Screen Deck

MRF Municipal Recycling Facility

Aggregate Recycling Program

Hydrocyclone Separator

Ortner Fines Separator
Wash water supplied from landfill groundwater diversion

Dewatering Screen #1

Scale Belt Conveyor Weigh Scales

Dewatering Screen #2

Water Reservoir Settling Pond

Stacking Conveyor
Fines stockpiled for drying and use as fillcrete Material

Fines stockpiled for drying and use as fillcrete Material

Stacking Conveyor
Sand stockpiled for drying to <5%
Use of Recycled Tires in Infrastructure Projects
Rubber Crumb in Hot Mix Asphalt

- In 2002 the City of Edmonton partnered with parties to investigate the use of used tire rubber crumb in hot mix asphalt.
# Asphalt Rubber Projects - City of Edmonton

<table>
<thead>
<tr>
<th>Year</th>
<th>Tonnage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006 Asphalt Rubber Projects</td>
<td>10,850</td>
</tr>
<tr>
<td>2005 Asphalt Rubber Projects</td>
<td>15,600</td>
</tr>
<tr>
<td>2004 Asphalt Rubber Projects</td>
<td>18,800</td>
</tr>
<tr>
<td>2003 Asphalt Rubber Projects</td>
<td>18,610</td>
</tr>
<tr>
<td>2002 Asphalt Rubber Projects</td>
<td>2,770</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>66,630</strong></td>
</tr>
</tbody>
</table>
Tire Shred in a Roadway Embankment

- In 2012 the City of Edmonton partnered with:
  - Alberta Transportation
  - University of Alberta
  - Alberta Recycling Management Authority
City of Edmonton Waste Management Center Access Road
Project X-Section

TDA TIRE TEST SECTION DETAIL
LOOKING NORTHERLY
RAISED CONTENT
Recycled Asphalt Pavement (RAP)

Recycled Asphalt Shingles (RAS)
RAP in Hot Mix Asphalt

1. MIX DESIGN AND PROPORTIONING (City of Edmonton Specifications Section 02966 – RECYCLED ASPHALT PAVING)

2. Submit a recycled asphalt mix design to Section 02065 – Hot-Mix Asphalt Concrete for the specified mix type based on the following maximum RAP content:

<table>
<thead>
<tr>
<th>Mix Type:</th>
<th>ACB</th>
<th>ACF-HT</th>
<th>ACF-LT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum RAP content (% by mass of total mix)</td>
<td>25</td>
<td>10</td>
<td>20</td>
</tr>
</tbody>
</table>
- Recycled Asphalt Shingles (RAS): pre-consumer or post consumer shingles that have been processed, sized, and are ready for incorporation into a hot-mix Asphalt mixture.

### 1. MIX DESIGN AND PROPORTIONING (City of Edmonton Specifications Section 02966 – RECYCLED ASPHALT PAVING)

### 2. Submit a recycled asphalt mix design to Section 02065 – Hot-Mix Asphalt Concrete for the specified mix type based on the following maximum RAP, RAS, or combination of Rap and RAS content:

<table>
<thead>
<tr>
<th>Mix type:</th>
<th>ACB</th>
<th>ACO</th>
<th>ACR</th>
</tr>
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<tbody>
<tr>
<td>Maximum RAP content if only using RAP in the mix (% by mass of total mix)</td>
<td>25</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Maximum RAS content if only using RAS in the mix (% by mass of total mix)</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Maximum RAP and RAS content if using both RAP and RAS in the mix, subject to the above noted individual maximums</td>
<td>25</td>
<td>10</td>
<td>20</td>
</tr>
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</table>
Full Depth Recycling (FDR)
What is Full Depth Recycling?

- Full Depth Cold Recycling as being discussed here is the cold rehabilitation technique in which the full thickness of the asphaltic pavement and a predetermined portion of the underlying materials (base and subbase) is uniformly pulverized and blended to provide an upgraded, homogeneous material.

- The term cold refers to the aggregate being cold during the process unlike traditional asphalt where aggregate is heated.
FDR Basics

Existing Construction

Addition of Secondary Stabilizing Agent or New Aggregate

Compaction water

Foaming water

Bitumen 180°C

Resulting Homogeneous Layer
Equipment Used: WR 2500sk
Results

- Viable technology for use on many different types of roadways;
- The structural capacity approaches 85% of hot laid asphalt mixes.
- Eliminates reflective cracking;
- No lengthy curing periods prior to overlay;
- Pre-engineering work by the owner is critical;
- Imported granular material can be used to cover any material gradation problem.
<table>
<thead>
<tr>
<th>Year</th>
<th>Total (m²)</th>
<th>Per year (m²)</th>
<th>Combined Total (m²)</th>
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<tbody>
<tr>
<td>2001</td>
<td>45,000</td>
<td></td>
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<tr>
<td>2002</td>
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<td>2005</td>
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<tr>
<td>2006</td>
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<td>2007</td>
<td>288,000</td>
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<td>2008</td>
<td>166,000</td>
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<td>2011</td>
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<tr>
<td>2012</td>
<td>557,000</td>
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</tr>
<tr>
<td>2013</td>
<td>600,000</td>
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4,046,000
We Even Recycle Snow...