PennDOT’s Strategic Recycling Program (SRP)
SMA-Crumb Rubber Projects Overview

A Presentation for PennDOT
Engineering District 3-0
PennDOT and Its Commitment to Environmental Stewardship

Strategic Environmental Management (SEM) Program Office Mission:

... “promote the incorporation of sound environmental practices and the effective application of environmental stewardship principles into PennDOT’s operations by providing technical assistance and quality assurance support in the fields of waste management, pollution prevention, recycling, and environmental management systems”
How Does the Overall Mission Apply to PennDOT Operations?

By implementing proper procedures and standards to road or highway construction or maintenance projects to ensure that environmental stewardship is practiced during such projects.
PennDOT Crumb Rubber Research Research

Background

National ISTEA Section 1038 Legislation (mid. 1990’s):

- Required crumb rubber from tires in asphalt paving in increasing quantities over a period of years
- PENNDOT began using 1% crumb rubber by weight of total hot-mix asphalt (HMA) base courses
- Results: 15-17% increase in cost of the HMA
- ISTEA repealed by states due to unpredictable performance results and increased costs
Other Regulatory Drivers:

**ACT 101 – Section 1506**

Required PennDOT to evaluate vendor proposals on products with recycled material content, or solid waste beneficial-use materials.

If evaluation process determines the material/product suitable, PENNDOT is required to revise its specifications to allow the use of the material/product.
PennDOT Crumb Rubber Research Background

PADEP Memorandum of Understanding (MOU) under Act 101:

- Funded by PADEP
- Allows PennDOT to issued recycled materials/products research and demonstration grants
Research Project No. 1995-054

Final Report

“Evaluation of the Tyrsolv Crumb Rubber Asphalt Modifier”

PENNDOT: ETID, BCM, March 2005
Project Description:

Three paving projects using Tyrsolv as asphalt modifier were placed.

“Tyrsolv” - chemically treated crumb rubber produced from waste tires

Manufacturer: Tyrplex Corporation (Duroplas)

Project included monitoring, testing and evaluations.
Tyrsolv Research Project No. 1995-054

Tyrsolv Project Locations
**Tyrsolv Project No. 1 – District 6-0**

**Location**: SR 0041, Chester County (1995)

**Project Scope**: CRM Wet Process

**Project Facts**:
- AADT (average annual daily traffic) 11,767
- 12% truck traffic, 1,139 average annual ESALs
- Total length paved: 3382 feet (test section)
- Mix: Marshall Method ID-2; 6% Tyrsolv CRM by weight of the asphalt binder
- Gradation of Tyrsolv CRM - coarse grade crumb rubber (100% minus the No. 40 sieve)
- Blending unit: high-shear blending unit
Issues / Results:
- Rubber in the asphalt binder separated and floated to the top of the plants asphalt binder storage tank (non-agitated storage)
- Actual percentage of CRM in asphalt binder unknown, field follow-up evaluation inconclusive.

Lessons learned:
- Store CRM with asphalt binder in agitated storage tanks.
Tyrsolv Project No. 2 – District 9-0

Location: SR 0070 (I-70), Fulton County (1998)
Project Scope: Wearing Course using CRM Wet Process

Project Facts:
- AADT (average annual daily traffic) 9,406
- 24% truck traffic, 2,035 average annual ESALs
- Total length: 5.4 miles (28,517 feet) (test sections)
- Mix: Superpave Asphalt Mixture Design, 12.5 mm, PG 64-22, Wearing Course (3,900 tons)
- 9% Tyrsolv CRM by weight of the asphalt binder
- Blending unit: large, low-shear blending unit
Issues / Results:

- Control sections and test section did not have same underlying construction

- Tyrsolv CRM larger gradation than expected (100% passing No. 40 sieve, not the No. 60), thus

- PG-Binder testing after modification indicated it was closer to PG 70-22

- Successful blending operation, no clogging of asphalt weigh bucket (as in Project No. 1)
Tyrsolv Project No. 3 – District 5-0

Location: (I-81), Schuylkill County (1998)

Project Scope: Wearing Course with CRM Dry Process

Project Facts:

- AADT (average annual daily traffic) 13,751
- 23% truck traffic, 2,738 average annual ESALs
- Total length: 5.2 miles (27,410 feet) – multiple experimental sections using two different source of CRM
- 9% & 13% Tyrsolv CRM by weight of the asphalt binder
- Blending unit: large, low-shear blending unit
Mix: Superpave Asphalt Mixture Design

1. HMA Wearing Course 19 mm, PG 64-22, modified with 13% Mahantango CRM
2. HMA Wearing Course 19 mm, PG 76-22 (control)
3. HMA Wearing Course 19 mm, PG 58-28, modified with 13% Tyrsolv CRM
4. HMA Wearing Course, 19 mm, PG-28, modified with 9% Tyrsolv CRM
5. HMA Wearing Course 19 mm, PG 64-22, modified with 9% Tyrsolv CRM
Issues / Results:

- Clogging problems encountered on 13% Tyrsolv CRM production at plant. Appearance dry and more open than comparable 13% Mahantango CRM section. Air voids 2% (vs. 4% target). Result: 13% CRM reduced to 9%.

- CRM mixture reduced (13% to 9%) on second third section.

- After CRM reductions, no further problems encountered.
## Overview of Projects

<table>
<thead>
<tr>
<th>Location SR Section Year</th>
<th>Rubber Process</th>
<th>Quantity of HMA (tons)</th>
<th>Quantity of CRM (lbs)</th>
<th>Bid Cost per ton</th>
<th>General Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0041 Chester Co. (1995)</td>
<td>Wet</td>
<td>400</td>
<td>Unknown</td>
<td>$ 32.10</td>
<td>Cost 7% higher than control</td>
</tr>
<tr>
<td>0070-009 Fulton County (1998)</td>
<td>Wet</td>
<td>3,900</td>
<td>35,800</td>
<td>$ 47.41</td>
<td>Cost 23% higher than control</td>
</tr>
<tr>
<td>0081-050 Schuylkill County (1998)</td>
<td>Dry</td>
<td>3,689</td>
<td>38,292</td>
<td>$ 78.00</td>
<td>Cost 13% higher than control</td>
</tr>
</tbody>
</table>
## Performance Overview

<table>
<thead>
<tr>
<th>Location</th>
<th>Rubber Process</th>
<th>Performance Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR 0041 Chester Co.</td>
<td>Wet</td>
<td>Because of production problems relating to non-agitated storage tank and crumb rubber separation, quantities of actual crumb rubber use is unknown.</td>
</tr>
<tr>
<td>SR 0070 Fulton Co. (1998)</td>
<td>Wet</td>
<td>Some cracking in CRM sections identified. Rut performance of CRM section evaluated as equal to control section (Superpave 12.5mm Wearing Course, PG 64-22).</td>
</tr>
<tr>
<td>SR 0081 Schuylkill Co. County (1998)</td>
<td>Dry</td>
<td>Rut performance of CRM section evaluated as similar to control section (Superpave 19mm Wearing Course, PG 76-22).</td>
</tr>
</tbody>
</table>
5-year Project Evaluation

- Visual evaluations & rut testing performed
- Skid testing
- Allows for numerous freeze-thaw cycles
- Allows for better performance of vehicular traffic
- SR-41 not performance-evaluated due to inconclusive quantity of CRM present in HMA mixture
Performance of I-70:

- Rutting performance comparable for all sections (control and CRM)
- Transverse and longitudinal cracking observed on CRM section.
  - Evaluation inconclusive if CRM mix contributed to longitudinal cracking
- Control sections showed no deformations, longitudinal or transverse cracking. Note: control sections had different underlying pavement construction (transverse joints sawed and sealed).
- Skid resistance (ASTM E 274) acceptable on CRM and control sections
Performance of I-81:

- Rutting performance best with control sections
- For rutting and surface defects, 9% CRM sections performed better than 13% CRM sections;
  - 9% Tyrsolv CRM PG 64-22 showed best test section results
- Skid resistance (ASTM E 274) acceptable on CRM and control sections
General Conclusions:

- CRM Sections exhibited no significant increase in rut performance
- Based on field evaluations, HMA Tyrsolv CRM can satisfactorily perform in high and heavy traffic areas
- I-81 Schuylkill County HMA, PG 64-22 modified with Mahantango CRM showed signs of moisture susceptibility in laboratory.
- CRM dry process requires less plant modifications
- CRM wet process requires portable blending unit and constant agitation
- HMA mixtures produced with PG 64-22 and modified with CRM added at 9% by weight of the total asphalt binder be considered for further use under provisional status
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