

Acceptance of Recycled Materials

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Little Know History Fact....



Give me your tires, your shingles, your broken glass yearning to be used freely, the wretched refuse of your bulging land fills. Send this tireless refuse to me. Lift your shovel of ash beside the incinerator door....

HMA Recycling

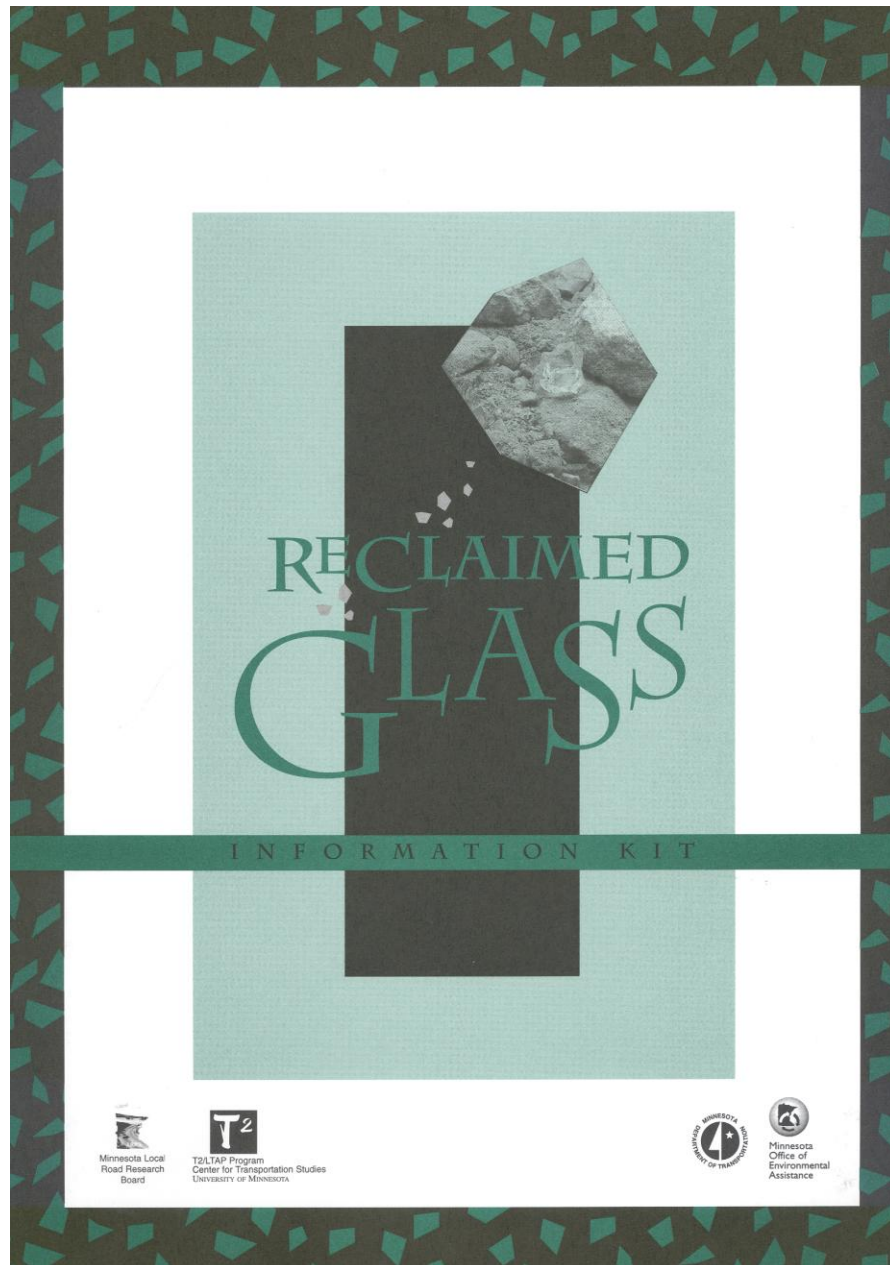
- Initially 70% Recycled Asphalt Pavement (RAP)
- 60% 1983
- 50% Base, 30% Wear 1995
- Currently
 - 20% to 40% RAP
 - QA/QC criteria

Aggregate Base Class 7 Specification

- Class 5 specification for aggregate base.
- Specification developed to identify recycled materials in aggregate base.
- Crushed Concrete, RAP identified
- Up to 10 percent by weight reclaimed material (glass).

Glass

- Class 7 allows glass proactively
(Engineer would need to write it out)
- Glass supply is non-uniform
- Tool Kit



HMA: Waste Products

- Taconite Tailings
- Incinerated Sewage Sludge Ash
- FDR / CIR
- Shingles
- Crumb Rubber

MnROAD Research Project Is Now “Green”

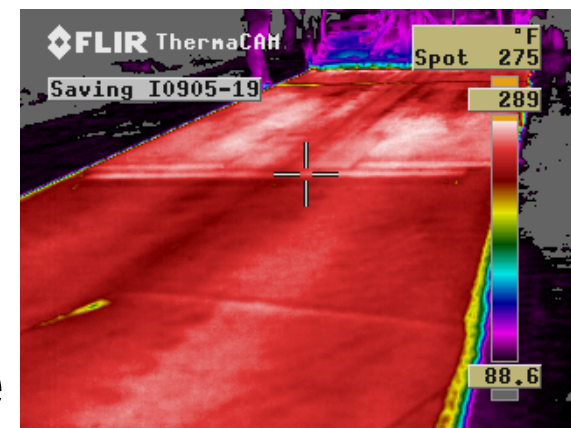


Introduction

- 6 Asphalt Binders
- 17 HMA Mixtures
- (Some concrete too)
- \$2.1 Million for Construction
- \$900,000 for Instrumentation
- \$250,000 for External Testing
- \$3.5 Million for Pooled Fund & Local Research

Warm Mix Asphalt

- Evotherm 3G – Gerald Reinke
 - Brainerd, Olmsted County projects
- PG 58-34, 20% RAP, Traffic Level 4
- 6 Cells on Mainline over different bases
- Cell 24 control mix on Low Volume Road
- 250°-275°F behind the paver
- 200°-220°F compaction temperature
- Rolling operations were much more efficient



Aging Study

Cell - 24									
Project: TPF-5(153) Optimal Timing of Preventative Maintenance to prevent aging									
Chip seal using a CRS-2P emulsion									
Control	Year 0	Year 1	Year 2	Year 3	Year 4	Control	Control (2)	No Semi Traffic	
Gravel Base	2008 Chip Seal	2009 Chip Seal	2010 Chip Seal	2011 Chip Seal	2012 Chip Seal	Gravel Base	Rehab Overlay of existing HMA	80K Semi (5 days week - 80 laps/day)	
30'	100'	100'	100'	100'	100'	45'	100'		
← 500' Test Cell →									
Layer Configuration									
3" 2008 HMA Overlay (PG 58-34) Superpave Level-4 (Warm Mix Gradation but Hot Mix - Control)							1993 Existing ~8" HMA Milled Pavement	12" PCC Loop	
4" Class-6 Granular Base (existing from 1993)									
~7 feet of Sand Subgrade (Fill)							Clay Subgrade		
Clay Subgrade									

Fractionated RAP

- 30% Non-Fractionated RAP
 - PG 58-28
- 30% Fractionated RAP (1/4" screen)
 - PG 58-28, PG 58-34
 - 20% Fine RAP, 10% Coarse RAP



Porous Asphalt

- Open-graded aggregate base (CA-15, **Ballast**)
- 18% Air Voids
 - Minimal Rolling Passes, Wait Until $<94^{\circ}\text{F}$!
- PG 70-28 binder based on TSR test
 - Supplemental Agreement
- Plant Issues
 - Wet aggregate
 - Baghouse
 - Plugged binder line



4.75 mm Superpave



- Taconite Tailings from 2 Sources
- Local Manufactured Sand
- PG 64-34
- 7.4% AC – 4% Air Voids
- Waived All Volumetric Requirements

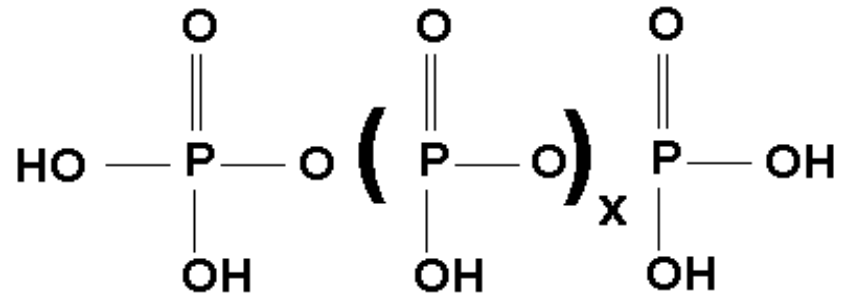
SemMaterials Research

- Full Depth Reclamation + Engineered Emulsion
 - No grade or slope control
- 2" Level 4 Superpave, PG 64-34
- 3/4" Novachip



Polyphosphoric Acid Study

- Stiffen asphalt at high temperatures
- No effect at low temps
- More cost-effective than polymers
- FHWA lab study
- Field validation needed
- April 7 & 8 PPA Workshop



Test Cell Designs

- PPA Only
- PPA + SBS
- SBS Only
- PPA + Elvaloy
- Level 3 Superpave
- PG 58-34 Binder
- No RAP
- Limited Limestone
- Hydrated Lime
- Liquid Antistrip

77	78	79	33	34	35
4" 58-34 Elvaloy + PPA	4" 58-34 Elvaloy + PPA	4" 58-34 Elvaloy + PPA	4" 58-34 PPA	4" 58-34 SBS +PPA	4" 58-34 SBS
8" Full Depth Reclam.	8" Class 6	8" Full Depth Reclam. + Fly Ash	12" Class 6	12" Class 6	12" Class 6
Clay	Clay	Clay	Clay	Clay	Clay

Unbound Base Study

- Pooled Fund, TPF(5)-129
- Cells 16-19 on Mainline I-94
 - 100% Crushed PCC
 - 50% Crushed PCC/Class 5
 - 100% Class5
 - 100% RAP
 - U of Wisconsin, Tuncer Edil P.I.

