'Recycled Tear-off Shingles Road Construction Demonstration in the Town of Hassan'

Final Report

Prepared for the
Local Road Research Boards (LRRB) Local Operational Research Assistance (OPERA) Program

May 31, 2007

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Project Summary

The Minnesota Local Road Research Board (LRRB), Local Operational Research Assistance (OPERA) grant for the *Recycled Tear-off Shingles Road Construction Demonstration in the Town of Hassan* was designed to support the ongoing research and development of the use of recycled tear-off shingles in hot-mix asphalt (HMA) applications. The project started as a partnership between the Town of Hassan and Omann Brothers, Inc., but quickly gained support from other local and state agencies. At the project 'kick-off' meeting in June 2006, the Minnesota Department of Transportation (Mn/DOT) and Hennepin county engineers expressed concerns that the test strip was too limited in size to give the needed outcome on the research goals. In response, partners involved in previous or on-going research in the area of shingle recycling were contacted. The design of this demonstration project offered new research on recycled asphalt shingles to further the development of a tear-off shingle specification by Mn/DOT and additional funding was approved to support this key research. The supplementary funding provided the following project support:

1. ***Expansion of the length of the test strip***. The test strip length was increased from a total length of 110 feet to 600 feet.
2. ***Additional mix types***. The expansion of the test strip allowed for the addition of four mix types:

   Original mix types:

   - Tear-off shingle scrap included at 5% of the total mix with a standard binder, PG58-28
   - Manufacturers' shingle scrap included at 5% of the total mix with a standard binder, PG58-28

   Additional mix types:

   - Tear-off shingle scrap included at 10% of the total mix with a standard binder, PG58-28
   - Manufacturers' shingle scrap include at 10% of the total mix with a standard binder, PG58-28
   - Tear-off shingle scrap included at 10% of the total mix with a softer binder, PG 52-34
   - "Virgin Only" Control section (no shingles included). This control section allows for both field and laboratory comparisons on the effects of shingles in pavement performance.

3. ***Additional laboratory testing by the University of Minnesota, Civil Engineering Department.***
4. ***Educational tools***

The following partners who provided funding to support this additional research are Mn/DOT (In-kind laboratory testing), Hennepin County, Dakota County, Solid Waste Management Coordinating Board (SWMCB), Environmental Protection Agency (EPA), Region

5/Construction Materials Resource Association (CMRA), Minnesota Protection Agency (MPCA)/Office of Environmental Assistance (OEA) and the University of Minnesota Civil Engineering Department.

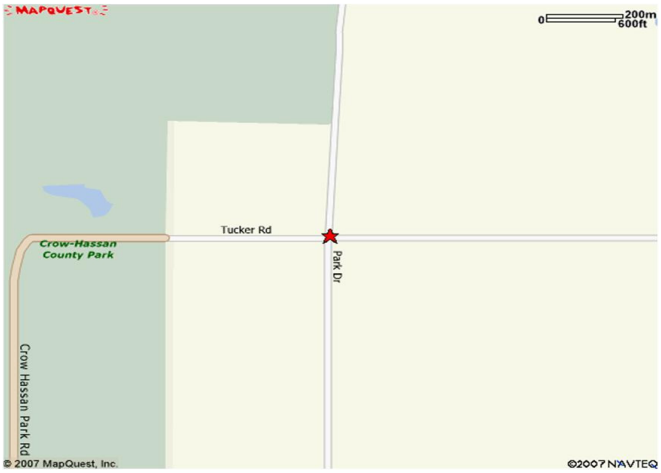
It is also important to point out the new research this project demonstration provides for Mn/DOT:

1. ***The HMA include recycled asphalt shingles (RAS) only***. No recycled asphalt pavement (RAP) was included. Previous Minnesota demonstrations have included a mixture of RAS with RAP in HMA applications. The use of RAS only in the mix designs will give Mn/DOT the ability to better separate out the effects of RAS in both field and laboratory testing.
2. ***Tear-off RAS was used in the wear course***. Previous Minnesota demonstrations have only used tear-off RAS in the base course.
3. ***Tear-off and Manufacturers' RAS were used in the wear course at 10% of the total mix***. Previous MN demonstrations have only used manufacturers' RAS at 5% of the total mix in the wear course.
4. ***A softer grade binder PG 52 - 34, was used in one test section with tear-off RAS at 10% of the total mix***. Due to the harder grade of asphalt in shingles, this section will test the performance of an increased percentage of RAS while using a softer grade of liquid asphalt.
5. ***A side by side field study on the performance of Tear-off and Manufacturers RAS in HMA.***

This project encouraged new research and advancement in the market development of shingle recycling by creating strong partnerships between county, city and state government sectors and through technology exchanges within the public and private sectors.

Project location:

The Town of Hassan selected a gravel road located at the intersection of Park Drive and Tucker Road in Hassan Township in Hennepin County, as shown in the map below:



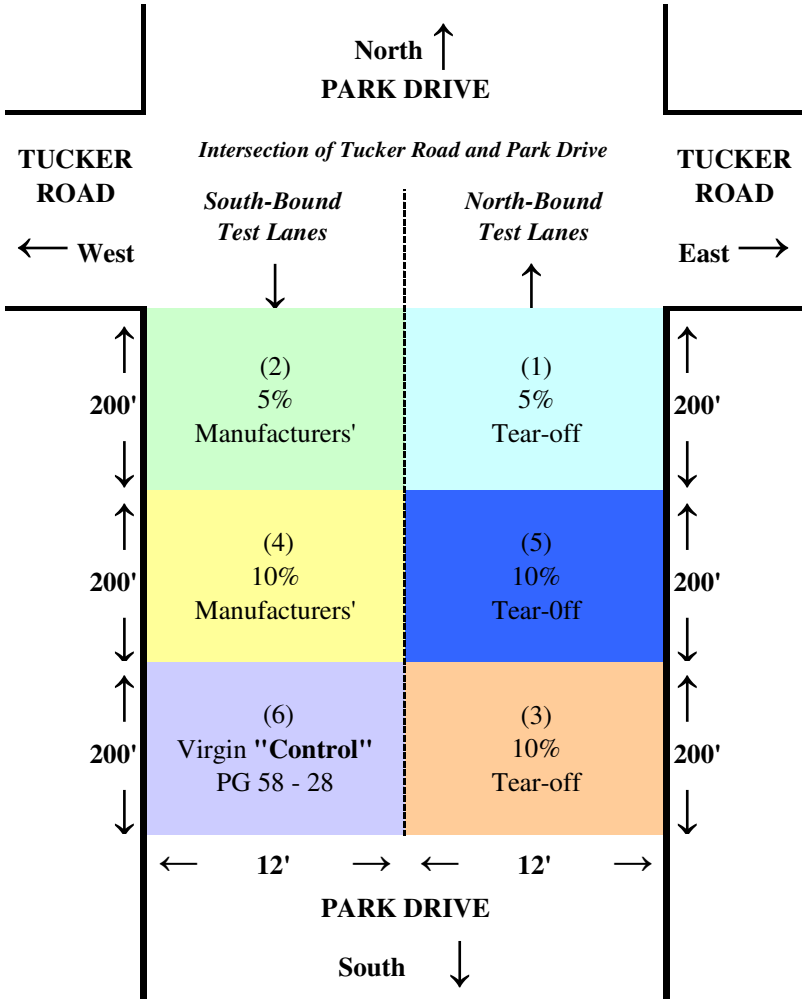
Park Drive is a paved road to the north of the intersection of Tucker Road and a gravel road to the south of the intersection. Tucker Road is a paved road to the east and west of the intersection. One of the reasons this intersection was selected was due to the gravel from Park Drive being

carried into the intersection by cars and trucks. This demonstration project improves the safety of the intersection by extending the pavement 600 feet to the south and reducing the gravel from being carried into the intersection.

Project design:

The project test strip begins at Tucker Road and runs south on Park drive for a total length of 600 feet. The total demonstration strip is 600 feet by 24 feet by 4 inches. The test strip was divided into six test-sections: three test-sections in the northbound lane and three test-sections in the southbound lane. Each test-section is 200 feet long by 12 feet wide as shown in the Plan View, Figure 1, below:

Figure 1



The final mix types for these test sections were determined by Hennepin County and Mn/DOT engineers. Three test-sections included tear-off shingles; two sections included manufacturers' shingles; and the final test-section was a 'virgin' control section (which included no RAS). A chart of the final mix types are shown in Table 1 below:

Table 1 - Mix Types for Hassan / Omann Demonstration

Test Lane Section I.d. No.	Type of Shingle Scrap, Binder	Lift	Lane of Traffic	Percent Tear-Off	Percent Manu-facturer	Virgin Binder PG Grade
(1a)	Tear-Off	Base	Northbound	5%	0%	58 - 28
(1b)	Tear-Off	Wear	Northbound	5%	0%	58 - 28
(2a)	Manufacturer	Base	Southbound	0%	5%	58 - 28
(2b)	Manufacturer	Wear	Southbound	0%	5%	58 - 28
(5a)	Tear-Off	Base	Northbound	5%	0%	58 - 28
(5b)	Tear-Off	Wear	Northbound	10%	0%	58 - 28
(4a)	Manufacturer	Base	Southbound	0%	5%	58 - 28
(4b)	Manufacturer	Wear	Southbound	0%	10%	58 - 28
(3a)	Tear-Off, Adjusted Binder	Base	Northbound	5%	0%	58 - 28
(3b)	Tear-Off, Adjusted Binder	Wear	Northbound	10%	0%	52 - 34*
(6a)	Virgin "Control"	Base	Southbound	0%	0%	58 - 28
(6b)	Virgin "Control"	Wear	Southbound	0%	0%	58 - 28

* Omann Brothers cleaned one of their asphalt binder tanks that normally held binder PG 58-28 for the delivery and use of the softer binder grade, PG 52-34. Due to a small amount of the standard binder, PG 58-28, remaining after cleaning the tank the softer binder PG 52-34 contained a small percentage of PG 58-28, approximately 1%, of the total binder PG 52-34 used in the mix design.

There are four unique mix-type properties used in this demonstration project:

- No recycled asphalt pavement (RAP) was included
- Manufacturers' RAS was used in the wear course at 10%
- Tear-off RAS was use in the wear course at 5% and 10%
- An adjusted binder, PG 52-34, was used with 10% tear-off RAS in the wear course

Previous Minnesota demonstrations using RAS in HMA applications have used mix types which included both RAS and RAP. In addition, previous project designs have only included tear-off shingles in the base course and manufacturer's RAS in the wear course at 5% of the total mix. The RAS only mix design will help to isolate the effects and performance of RAS in HMA in both the laboratory and field testing. Previous laboratory tests have shown that tear-off shingles, due to the weathering, increase the binder stiffness of the HMA mix. The theory of using the softer binder (PG 52-34) in the wear course in test-section 3(b) using tear-off RAS at 10% of the

total mix [see Figure 3 below] was to oppose the stiffing factor of the tear-off shingles and create a final mix that would perform as a well as a standard HMA mix. Test-section 3(b) was paved end to end with the test-section 5(b) using PG 58-28 and 10% tear-off RAS and side by side with the 'virgin control' section 6(b) [see Figure 1, Plan View] for field comparison on the pavement performance. The mix designs for the *base course*, Lift 1, for all test-sections in both lanes were consistent in percentage of RAS used (5%) and the use of binder grade PG 58-28. The *wear course*, Lift 2, mix designs varied in both percentage of RAS. The use of the softer binder, PG 52-34 was **only** used in the wear course of test-section, 3(b). Cross-sections showing the mix designs for each lift in the southbound and northbound lanes are shown below in Figures 2 and 3:

Figure 2

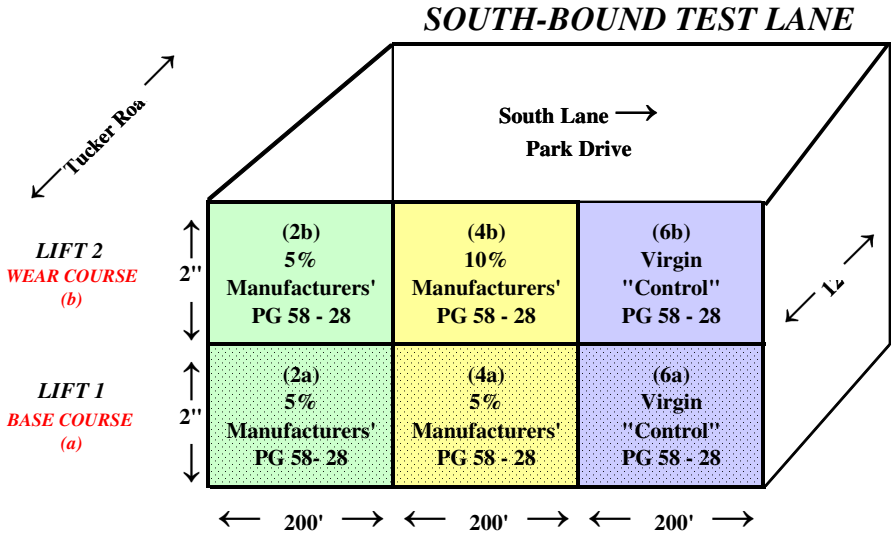
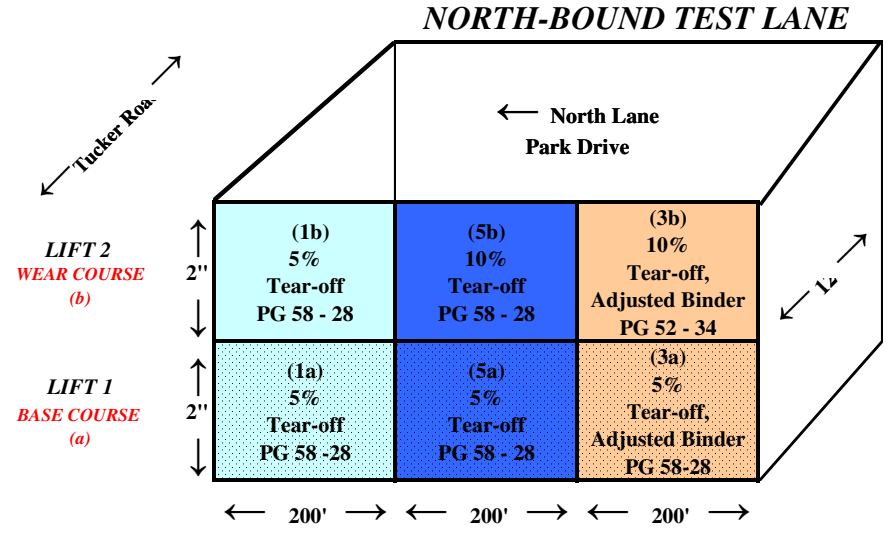


Figure 3



Note: ***Numbering in cross-sections above are consistent with the Test Lane Section ID No.'s in Table 1.***

Grinding of Shingles:

Manufacturers' Shingle Scrap

Oman Brothers used previously stockpiled manufacturers' shingle scrap for this project demonstration, which contained primarily organic or paper backings. The grinding of the manufacturers' shingle scrap was conducted on-site prior to the grinding of the tear-off shingle scrap. The manufacturers' shingle scrap was ground to a size of ½ inch minus

Tear-off Shingle Scrap

Omann Brothers worked together with G.L. Roofing Company to obtain a certified source of clean roofing shingles. One of the important issues in the use of tear-off shingle scrap is the need to separate the roofing shingles from debris that may contaminate the hot-mix asphalt. Debris can be defined as items such as metal flashings, wood, paper and plastic. For this demonstration project 12 tons of roofing shingles (approximately three residential homes) were sorted on-site by the roofing company, delivered to Omann's asphalt plant and stockpiled separately. To assure that no asbestos containing materials were recycled, G.L Roofing and Omann Brothers certified in writing that the tear-off shingles came from private, single family, residential homes. Residential homes are not regulated by the state agencies that require asbestos testing. A sample copy of the certification forms are attached as Appendix A. Nail removal is completed during the grinding process.

On July 18, 2006, Mn/DOT and Hennepin County staff observed the grinding of the tear-off shingles at Omann Brothers Asphalt Plant. Omann Brothers has a unique and patented grinding system. The shingles were ground in three phases, which included three magnets and one metal sensor. The shingles were reduced to a size of ½ inch minus, free of nails and debris and ready for use in the hot-mix pavement. Because the shingles were ground one month prior to the paving, the final stockpiled product was quickly run through the grinder one more time to remove any clumping that may have occurred before being metered into the asphalt plant to assure a quality hot-mix.

Paving:

On August 22, 2006, Omann Brothers first graded and then compacted the gravel road in preparation for the paving. On August 23, 2006, the base course of hot-mix asphalt was applied. Due to weather conditions on August 24th the wear course was applied on August 25th. A tack coat was applied prior to the wear course. Total truck loads and tonnage for each section and lift are summarized in Table 2 below:

Table 2 - Tonnage of Hot-Mix Asphalt (HMA)

Test Lane Section I.d. No.	Type of Shingle Scrap, Binder	Lift	Lane of Traffic	Percent Tear-Off	Percent Manufacturers RAS	Tons of Tear-off RAS	Tons of Manufacturers' RAS	Total tons of HMA	Truck Loads
(1a)	Tear-Off	Base	Northbound	5%	0%	1.5	0	30	2
(1b)	Tear-Off	Wear	Northbound	5%	0%	1.5	0	30	2
(2a)	Manufacturer	Base	Southbound	0%	5%	0	1.5	30	2
(2b)	Manufacturer	Wear	Southbound	0%	5%	0	1.5	30	2
(5a)	Tear-Off	Base	Northbound	5%	0%	1.5	0	30	2
(5b)	Tear-Off	Wear	Northbound	10%	0%	3.0	0	30	2
(4a)	Manufacturer	Base	Southbound	0%	5%	0	1.5	30	2
(4b)	Manufacturer	Wear	Southbound	0%	10%	0	3.0	30	2
(3a)	Tear-Off,	Base	Northbound	5%	0%	1.5	0	30	2
(3b)	Tear-Off,	Wear	Northbound	10%	0%	3.0	0	30	2
(6a)	Virgin	Base	Southbound	0%	0%	0	0	30	2
(6b)	Virgin	Wear	Southbound	0%	0%	0	0	30	2
					Total Tonnage:	**12.0**	**7.5**	**360**	

Sample Collection:

Prior to the paving, Hennepin County collected one quart of each binder grade, PG 58-28 and PG 52-34, from Omann Brothers Asphalt Plant. During the paving operations Hennepin County collected three buckets of HMA product from behind the pavers from each test-section for the IDT tests conducted by the University of Minnesota Civil Engineering Department. A total of 18 buckets of loose material were collected. The week of September 9th, 2006, Hennepin County collected ten 4-inch core samples from each test section for a total of 60 core samples. These samples were delivered to Mn/DOT's Office of Materials and Road Research for laboratory testing.

Laboratory Testing:

As a part of this project demonstration, Mn/DOT committed a significant amount of in-kind lab testing and analysis. The Mn/DOT Office of Materials and Road Research bituminous, aggregate and chemical labs conducted the following tests:

- Core Density Testing (voids)
- % Binder Extraction
- Bending Beam Rheometer (PG Grading test)
- Deleterious
    - Total Fiber
    - ASSHTO Method

In addition to these tests, the Mn/DOT bituminous lab also created six-inch gyratory pucks from the loose material collected from behind the pavers. These six-inch pucks along were delivered to the University of Minnesota Civil Engineering Lab for additional laboratory tests.

The Civil Engineering Lab conducted the following laboratory test:

- IDT tests with the 6-inch gyratory pucks

The tentative schedule for the final laboratory results is June 2007.

Visual Field/Crack Survey:

In completing research on road construction, it is important that the laboratory results be looked at along with the field results. The ultimate validation for the performance of HMA is to pave the road and observe the results.

In March 2007, Mn/DOT staff completed a field survey of the test strip. Cracking and rutting conditions were surveyed. No cracking was observed in any of the test sections. Rutting measurements were taken and will be used as the baseline for comparison of future measurements. A second survey is scheduled for the fall of 2007. It was noted that there was some slight rutting at the intersection, which may be from traffic slowing to make a turn. Omann Brothers Inc., also mentioned that the rutting could be caused from a the pavers laying a thicker amount of HMA at the intersection, causing the compaction of the HMA to be slightly less than the required pavement performance reached within the other area's of the test-section

Media Coverage:

A news release was issued by the Hennepin County Public Affairs Office on August 21st, 2006 (Attached as Appendix B). The following coverage was gained in response to this release:

- WCCO broadcast a two short announcement on the morning of August 22, 2006. They broadcast included a brief interview with Greg Chock from Hennepin County.
- MPR broadcast two newscasts from an interview with Greg Chock, Hennepin County. These newscasts ran over the weekend of Aug 25th-Aug 27th, 2006.
- The Finance & Commerce Journal printed an article in their Construction section on Tuesday, August 29, 2006.
- Northwest Community TV & Channel 12 camera crews were on-site for the wear course paving on August 25, 2006. The news coverage was broadcast on August 29, 2006 and included an interview with Greg Chock from Hennepin County.
- The Minnesota Local Technical Assistance Program (MnLTAP) published an article in the Fall of 2006 issue Technology Exchange.

Technology Exchange

- This project demonstration was shared at the Minnesota Asphalt Pavement Associations (MAPA) 51st Annual Asphalt Contractors Workshop at SWMCB's Exhibit Booth. A short summary with pictures was displayed and a video of the Channel 12 Broadcast was shown.
- A panel of partners from the Hassan / Omann Demonstration presented at the Center for Transportation Studies (CTS) 18th Annual Transportation Research Conference, May 1-2, 2007. The panel, ***'Case Study on Research and Implementation Partnerships: Using Tear-off Shingles in Pavements'*** was held on May 1, 2007.
- A video of the Hassan /Omann Demonstration, sponsored by Dakota County and with the technical support of the Minnesota Pollution Control Agency's Office of Environmental Assistance (MPCA/OEA) and the Minnesota Department of Natural Resources is available for on-line viewing at the following link: http://web.mac.com/jrstu/iWeb/Site/Shingle%20Recycling.html
- This case study, project reports and video will be posted on the ShingleRecycling.org website.

- A 'bag lunch' presentation of the project demonstration will be held for Hennepin County staff on July 11, 2007. The results of the laboratory testing will be presented at this luncheon.

On-going Research

- A workshop on tear-off shingle recycling will be held by Dakota County in the fall of 2007. The workshop goal is educate and create a round-table discussion on tear-off shingles between various private and public partners involved in the use of RAS within Dakota County.
- A technical advisory group is being initiated with the support of the SWMCB's 2007 *Shingles Recycling Project*. The main objectives for this group are to review past and on-going research on RAS, to discuss and recommend next research needs, and to help coordinate and develop a draft tear-off specification.
- Ramsey County will be paving the Lower Afton Bike trail using tear-off shingles in the summer of 2007, with technical assistance from Mn/DOT.
- Washington County is reviewing potential projects for 2007 that include recycled asphalt shingles.

Traffic Safety

The Town of Hassan selected this section of gravel road for the demonstration in part to address a safety concern at the intersection. With the large amount of truck and car traffic a significant amount of gravel was being carried into the intersection from Park Avenue. As you can see below in Picture 1 and 2, the paved test section has addressed this concern.

Picture 1

This picture is taken at the start of the project test strip, looking south on Park Drive at the intersection of Tucker Road. The intersection stays free of gravel.

Picture 2

This picture is taken at the end of the test strip, looking north on Park Drive, from where the gravel road starts again. You can see how the gravel is carried onto the blacktop from the cars and truck traffic.

Potential Statewide Implementation:

The partnerships created on behalf of this project demonstration show the public and private interest in promoting the use and recycling of tear-off shingles. The cost of virgin asphalt prices have soared in the last year and the cost savings to the HMA producer passed on to the buyers is growing and significant. In addition, the space saved by the recycling of tear-off shingles is a benefit to state and private sector landfill operators. The future for shingle recycling is expanding from HMA applications to many other applications such as fuel for cement kilns or biomass gasification plants. The laboratory and field results of this project will provide useful information for Mn/DOT on the performance of recycled asphalt shingles in HMA and lead to continued discussion and development of a tear-off specification.

Another benefit this demonstration provides to local and state agencies are the steps needed to guarantee quality control during the grinding and paving of HMA using RAS. Quality control, second to the economic value of the virgin asphalt found in RAS, are essential drivers to the state-wide implementation and market development of recycled shingles.

Appendix A

'Scrap Shingle Certification Sheets'

(For Tear-off Shingle Scrap)

FROM-OMANN BROTHERS 002/002 F-788

Scrap Shingle Certification Sheet

Processor

Paving project site information:

Paving project name: Park Dr. Hassan Twp. Test strip.

Paving project owner: Hassan Township

Contact person / phone: Bill Boettner

Paving project location (address, city): Park Dr. Rogers

Shingle recycling processor:

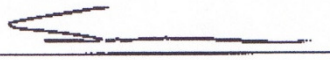
Company name: Omann Shingle Recycling

Contact person / phone: Scott Omann

Address: 6551 LaBeaux Ave NE PO Box 120
Albertville MN 55301

E-mail: Somann@Omanninc.com

We the undersigned, certify that: (1) All of the tear-off shingle scrap to be used on this project came from residential buildings having four or fewer dwelling units; and (2) These residential buildings can not be defined as an institutional or commercial "facility" according to state and federal regulations. We certify that the material processed consisted of asphalt shingles only and contains no known hazardous material.



7-18-06

Processor of shingle scrap (signature) **Date**

NOV-07-2006 04:50PM FROM-OMANN BROTHERS +763-497-8261 T-325 P.005/005 F-617

Scrap Shingle Certification Sheet
(For "Tear-Off" Shingle Scrap)

From the Roofing Company
As a Supplier of Tear-Off Shingle Scrap

Roofing Company Name: GL Roofing, LLC

Address: 6719 Oakwood Ave NE
Otsego, MN 55330

Contact: Gary Lindenfelser

Phone: 763-241-0917

E-mail: tgzdee1@msn.com

We the undersigned, certify that:

1. All tear-off shingle scrap came from residential buildings having four or fewer dwelling units (see addresses below or attached);
2. These residential buildings are not "regulated facilities" according to state and federal rules; and
3. The roofing waste material delivered consists of asphalt shingles and normal roofing debris only and contains no known hazardous material (e.g., asbestos).

Residential re-roof customer address(es) where the tear-off shingle scrap came from:

8606 Ogren AVE N.E
Otsego, MN 55330

(Please attach additional sheets as needed to record each customer address)

Name and address of processor where the shingle scrap was supplied to:

Omann Brothers
13045-42nd Street NE
St. Michael, MN 55376

Signature of Roofing Company

6/30/06
Date

34+SQ 1-Load

Appendix B

'Hennepin County News Release'

Hennepin County **News**

Public Affairs • 612-348-3848 • 300 S. 6th St., Minneapolis, MN 55487-0011

Aug. 21, 2006

Contact: Greg Chock, Hennepin County Transportation Department, 612-596-0330
Deb Haugen, Dan Krivit & Associates, 612-220-7322
John Knudsen, Hennepin County Public Affairs, 612-348-6883

Agencies test use of asphalt containing recycled shingles

Hot-mix asphalt -- containing test mixes of recycled roofing shingles -- is being used to pave a Hassan Township road in northwestern Hennepin County.

Using "tear-off" (post-consumer) shingles from houses and other buildings in hot-mix asphalt is the focus of on-going research by several agencies, including the Minnesota Department of Transportation (Mn/DOT), the Hennepin County Transportation Department, the Solid Waste Management Coordinating Board and the University of Minnesota's Civil Engineering Department.

A primary goal of this field test is to draft a new tear-off shingles specification. Currently, Mn/DOT specifications allow only manufacturers' shingle scrap to be used in hot-mix asphalt.

"This project will allow our engineering staff and those from other agencies to view first-hand the comparison in pavement performance between different test mixes of asphalt containing tear-off shingles," said Greg Chock, the Hennepin County Transportation Department's Operation Division manager. "The demonstration also is consistent with Hennepin's County's commitment to the environment since the used shingles would otherwise end up in landfills."

Omann Brothers, Inc., is the shingle recycler, hot-mix producer and paving contractor for the Hassan test project. The company will produce various test mixes of

- more -

Shingles recycling/2

asphalt containing tear-off shingles and pave sections of Park Drive immediately south of the intersection with Tucker Drive in Hassan Township Wednesday, Aug. 23, and Thursday, Aug. 24.

In recent years, the Hennepin Transportation Department has supported the research, development and implementation of the recycling of manufacturers' shingle scrap. The county will pave approximately 125 lane miles of road this year, with 77 lane miles of new pavement containing 5-percent manufacturer's shingle scrap.

Research and testing has shown that shingle scrap produces a hot mix of equal or better quality, while offering potential cost savings and measurable benefits to the environment by reducing landfill waste.

- 30 -

Editors: If you are interested in taking photos, shooting video or an interview, Greg Chock, the Hennepin County Transportation Department's Operations Division manager, will be on-site for the paving about 11 a.m. Thursday, Aug. 24.

Look for more news on the Hennepin County website – www.hennepin.us .