RECLAIMED MANUFACTURER ASPHALT ROOFING SHINGLES IN ASPHALT MIXTURES

Research Project No. 91-77

FINAL REPORT

April 1999

By
Andrew B. Reed, P.E.

PENNSYLVANIA DEPARTMENT OF TRANSPORTATION
Bureau of Construction and Materials
Engineering, Technology, and Information Division

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PHOTOGRAPHS

Metric Conversion Factors*

To Convert From:	To:	Multiply By:
Length		
foot (ft)	meter (m)	0.3048
inch (in)	millimeter (mm)	25.4
yard (yd)	meter (m)	0.9144
mile (statute)	kilometer (km)	1.609
Area		
square foot (ft^2)	square meter (m^2)	0.0929
square inch (in^2)	square centimeter (cm^2)	6.451
square yard (yd^2)	square meter (m^2)	0.8361
Volume		
cubic foot (ft^3)	cubic meter (m^3)	0.02832
cubic yard (yd^3)	cubic meter (m^3)	0.00315
gallon (U.S. liquid)	cubic meter (m^3)	0.004546
ounce (U.S. liquid)	cubic centimeter (cm^3)	29.57
Mass		
ounce-mass (avdp)	gram (g)	28.35
pound-mass (avdp)	kilogram (kg)	0.4536
ton (metric)	kilogram (kg)	1000
ton (short, 2000 lbm)	kilogram (kg)	907.2
Density		
pound-mass/cubic foot	kilogram/cubic meter (kg/m^3)	16.02
mass/cubic yard	kilogram/cubic meter (kg/m^3)	0.5933
pound-mass/gallon(U.S.)**	kilogram/cubic meter (kg/m^3)	119.8
pound-mass/gallon(Can.)*	kilogram/cubic meter (kg/m^3)	99.78
Temperature		
deg Celsius (°C)	kelvin (°K)	$t^{\circ}K = (t^{\circ}C + 273.15)$
deg Fahrenheit (°F)	kelvin (°K)	$t^{\circ}K = (t^{\circ}F + 459.67) / 1.8$
deg Fahrenheit (°F)	deg Celsius (°C)	$t^{\circ}C = (t^{\circ}F - 32) / 1.8$

* The reference source for information on SI units and more exact conversion factors is "Metric Practice Guide" ASTM E380.

** One U.S. gallon equals 0.8327 Canadian gallon.

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INTRODUCTION

Pennsylvania is actively pursuing methods to recycle materials in construction projects. The nearly 80 roofing shingle factories in the U.S.A. produce around 10 million tons of shingles per year. Of that, approximately 750,000 tons are shingle scraps consisting of punch out tabs and damaged shingles [Waller and May, 1993]. Recycling would preclude shingle tabs from being disposed in landfills. This would save the disposal cost of $30 to $50 per ton [NAPA, 1997].

Asphalt shingles contain asphalt, sand, and filler which are common ingredients in hot mix asphalt. Consequently, shingles pieces can be recycled by being added to hot mix asphalt without considerable adverse affects.

Post-consumer roofing shingles were not included in this experimental project. A primary concern with the use of post-consumer material is that the shingles could contain asbestos. Another concern is that while the quality of shingles from factory scrap can be monitored reasonably well, monitoring the quality and maintaining the consistency of shingles coming from post-consumer sources would be much more difficult to do.

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OBJECTIVE

The purpose of this project was to pave a test section using hot mix asphalt with roofing shingle pieces in the wearing and binder courses and to evaluate the constructability, mix properties, and performance of the pavement. After a five year evaluation period, the Department would determine the suitability of adding roofing shingles to asphalt pavements as an acceptable standard practice. The addition of the fiberglass shingles to hot mix asphalt was expected to stiffen the pavement and help reduce the amount of required virgin asphalt and potentially help resist pavement rutting.

Four types of pavement sections were placed. One was a control section of a standard ID-2 wearing, and binder courses without shingles. Three experimental sections consisted of a

wearing and binder course of ID-2 with shingles, a wearing of ID-2 with shingles and a standard binder course, and a standard wearing course and an ID-2 binder course with shingles.

LOCATION

For this project, a local road in Lehigh County was selected. The site is located on relocated Saucon Valley Road (Stabler Park Road), west of Allentown, Pennsylvania in PennDOT District 5-0. Figure-1 shows the project location. Figure-2 shows the project plan view. This road is a low volume road leading to an industrial park. Approximately 1,150 linear feet of the westbound lanes were paved with 154 tons of hot mix asphalt modified with shingles on July 16, 1991. The westbound passing lane had 1,125 feet paved and the westbound travel lane had 1,228 feet paved.

The westbound travel and passing lanes on the east and west sides of the test project area were paved with ID-2 wearing and binder course in the summer of 1991. The eastbound travel and passing lanes were also paved with ID-2 wearing and binder course in this time period. This allowed for direct comparisons to be made between the test sections with shingles and control sections.

MATERIAL

The mix producer was Eastern Industries, Inc. of Ormrod, PA. Sun Refining Company provided the AC-20 asphalt binder. The shingle pieces were obtained from Georgia Pacific in Quakertown, PA. The shingle pieces consisted of cut-out tabs measuring ¼-inches wide by 5-inches long. After shredding, the shingle pieces were ¼ inch wide by a maximum ½ inch long. The material primarily consisted of asphalt, sand and fiberglass. Refer to photographs 1 and 2 to see the shredded manufacturer's shingles tabs.

The shingles pieces were added to an ID-2 wearing mix and to an ID-2 binder mix at a rate of 5 percent by weight. The shingles were added cold by a hopper and a conveyor system directly into the batch plant. The shingles were added to the hot aggregates before any asphalt was added into the mix. The shingles melted into the mix.

Very fine ½-inch long fiberglass fibers could be observed in the fresh mix. The mix also looked rich with asphalt content.

MIX DESIGN

The job mix formula (JMF) and mix characteristics are presented on Tables 1, 2, and 3. Table 1 shows the JMF for the ID-2 Wearing Course with fiberglass shingles. Table 2 shows the JMF for the ID-2 Binder Course with fiberglass shingles. Table 3 shows the JMF for the ID-2 Wearing Course without shingles. The total asphalt content of the ID-2 wearing mix design was 6.3%. The shingles provided 1.0% of the asphalt content. The remaining 5.3% of the asphalt content was added as virgin AC-20.

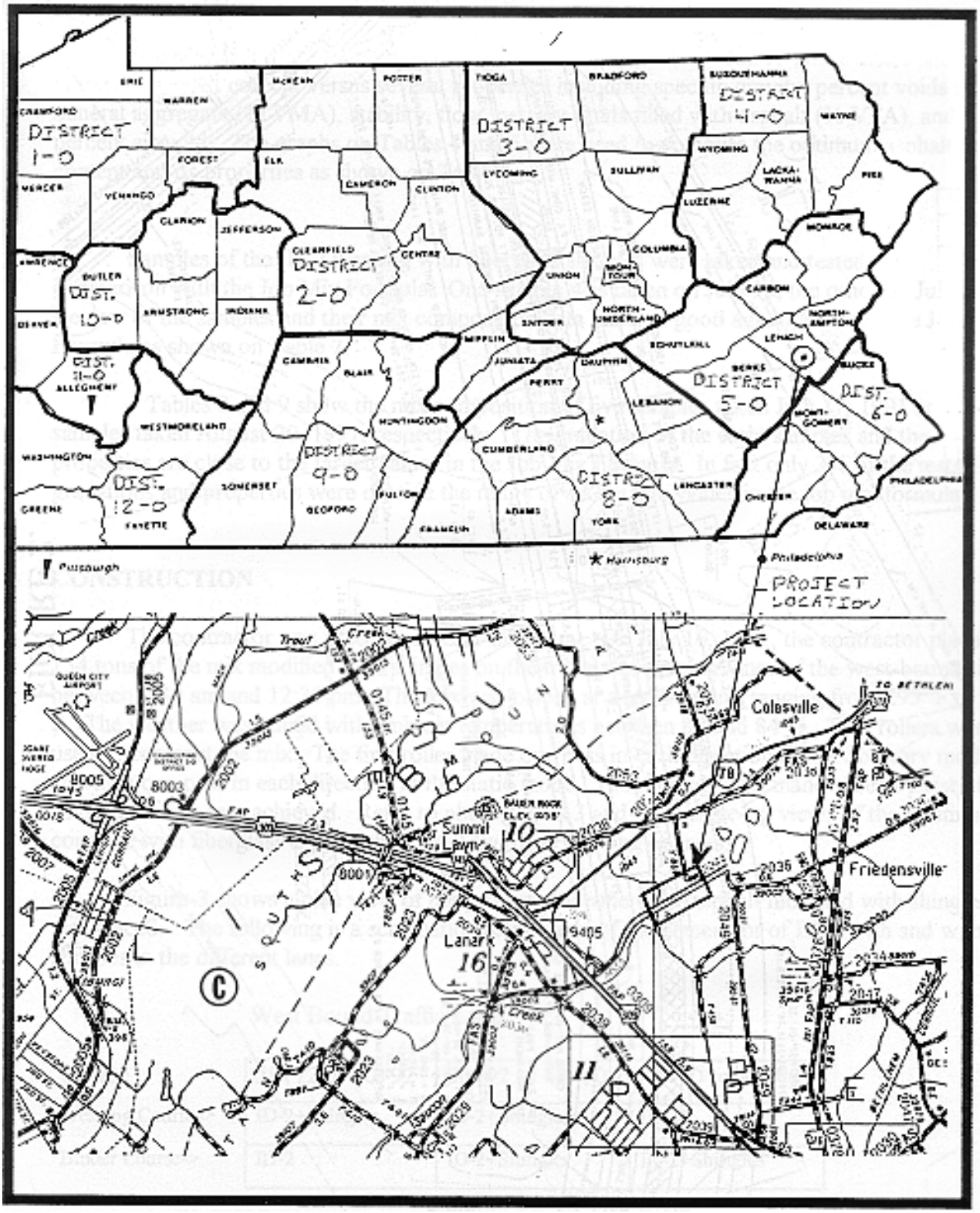

Figure 1. Location Map
District 5-0"s Paving Project with Shredded Roofing Shingles
Saucon Valley Road, Lehigh County, Pa

For Copy of Figure 2 – PROJECT PLAN VIEW
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The Marshall Mix Design Summary is presented in Tables 4 and 5. These tables show graphs of asphalt content versus several properties including specific gravity, percent voids in mineral aggregate (% VMA), stability, flow, percent voids filled with asphalt (% VFA), and percent air voids. The graphs on Tables 4 and 5 were used to compute the optimum asphalt content and its properties as shown on Table 6.

Samples of the ID-2 wearing with fiberglass shingles were taken and tested for comparison with the Job Mix Formula. One sample was taken on July 16, the other on July 17. Review of the samples and their mix composition data indicate good agreement with the Job Mix Formula as shown on Table 7.

Tables 8 and 9 show the mix composition of five samples taken July 17, 1991 and three samples taken August 20, 1991, respectively. The gradation of the eight samples and the mix properties are close to the target values in the Job Mix Formula. In fact only 3% of the tested gradations and properties were outside the range of acceptable values in the job mix formula.

CONSTRUCTION

The contractor was Elco-Hausmann Company. On July 16, 1991, the contractor placed 154 tons of the mix modified with shingles on the travel and passing lanes of the west-bound side between 9:30 am and 12:30 pm. The mix was placed at a temperature ranging from 295 F to 300 F. The weather was humid with ambient temperatures between 82 and 84 F. Two rollers were used to compact the mix. The first roller made one pass in each direction in the vibratory mode and then one pass in each direction in the static mode. The second roller made several passes till a smooth surface was achieved. Refer to photographs 3 and 4 for close-up views of the bituminous concrete with fiberglass asphalt shingles in the ID-2 wearing courses.

Figure-3 shows a plan view of the project area where the asphalt modified with shingles was placed. The following is a schematic presentation of the placement of ID-2 with and without shingles in the different lanes.

West Bound Traffic Lane

Station	28+72 to 30+92	30+92 to 40+50	40+50 to 41+00
Wearing Course->	ID-2+Shingles	ID-2+Shingles	ID-2
Binder Course->	ID-2	ID-2+Shingles	ID-2+Shingles

West Bound Passing Lane

Station	29+75 to 40+15	40+15 to 41+00
Wearing Course->	ID-2+Shingles	ID-2
Binder Course->	ID-2+Shingles	ID-2+Shingles

West Bound Lanes East Bound

Station	W.B. Travel <28+72 & >41+00	W.B. Passing <29+75 & >41+00	Lanes All Stations
Wearing Course->	ID-2	ID-2	ID-2
Binder Course->	ID-2	ID-2	ID-2

PERFORMANCE REVIEWS

May 1992

The site was visited during construction (July 16, 1991), two weeks after construction (July 30, 1991) and ten months after construction (May 8, 1992). Based on the field observations, the pavement appeared in good condition in both lanes with and without the shingles. Therefore, no conclusions could be made as to whether the addition of the shingles had improved the performance of the pavement.

December, 1994

The site was inspected 3 years and 5 months after construction. The surface matrix of both types of wearing courses had a slight loss of fine aggregate. This loss did not appear to have any detrimental effect on the performance of the wearing courses. The only detectable distress was an intermittent crack occurring at the longitudinal center line joint between the travel lane and passing lane which occurred in all 4 test sections. The test sections, with shingles in either the wearing, or binder courses or both, were in good condition and looked very similar to the control sections which were without shingles.

For Copy of Figure 3 – PROJECT PLAN VIEW
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August, 1995

A four year evaluation of the project was done on August 17, 1995. The ID-2 bituminous wearing course with 5% shingles appeared to be in a similar condition to the wearing course without shingles. Both wearing courses showed a slight loss of fine aggregates at the surface and appeared similar in color. Neither course showed any signs of measurable rutting or permanent deformation.

Longitudinal, center line joint cracking between the travel lane and the passing lane appeared at the surface of both of the wearing courses. The cracking was less than 1/8 inch wide. It appeared that the longitudinal, centerline joint cracking varied between the different pavement sections. The pavement sections with the 5% shingles in both the wearing and binder courses, had the most longitudinal, centerline joint cracking. The control sections, the pavement sections without shingles in either the wearing or binder courses had the least amount of longitudinal, centerline cracking. Such cracking in the control sections occurred more in the westbound traffic lanes, on the east and west ends of the project, than in the eastbound traffic lanes.

For each of the pavement sections, the approximate percentage of the total section length that displayed longitudinal, center line cracking is given below:

Traffic Direction	Pavement Section	Approximate Percentage of Total Section Length with Longitudinal, Center Line Joint Cracking
Eastbound (Sta 26+00 to 43+00)	2 inches, ID-2 Bituminous Binder Course 1 ½ inches, ID-2 Bituminous Wearing Course (Control)	50%
Westbound (Sta 26+00 to 28+72)	2 inches, ID-2 Bituminous Binder Course 1 ½ inches, ID-2 Bituminous Wearing Course (Control)	70%
Westbound (Sta 28+72 to 30+92)	2 inches, ID-2 Bituminous Binder Course 1 ½ inches, ID-2 Bituminous Wearing Course with 5% Fiberglass Asphalt Shingles	60%
Westbound (Sta 30+92 to 40+15)	2 inches, ID-2 Bituminous Binder Course with 5% Fiberglass Asphalt Shingles 1 ½ inches, ID-2 Bituminous Wearing Course with 5% Fiberglass Asphalt Shingles	85%
Westbound (Sta 40+50 to 41+00)	2 inches, ID-2 Bituminous Binder Course with 5% Fiberglass Asphalt Shingles 1 ½ inches, ID-2 Bituminous Wearing Course	50%

Westbound (Sta 41+00 to 43+00)	2 inches, ID-2 Bituminous Binder Course 1 ½ inches, ID-2 Bituminous Wearing Course (Control)	50%

By the four year evaluation, the pavement with the shingles in the wearing course showed more longitudinal, center line joint cracking than the pavement sections without the shingles. This may indicate that more aging of the asphalt occurs in the pavement sections with shingles compared to those without shingles. This was the only apparent difference between the pavement sections with and without the 5% asphalt shingles. No other cracking was present in any of the pavement sections. Refer to photograph 5 to see the westbound travel lanes at Sta 36+90 which had shingles in the wearing and binder courses.

November 24, 1997

The control sections had intermittent centerline longitudinal joint cracking. The cracks were not continuous and were a maximum 1/8 inch wide. The pavement sections with the 5% shingles in both the wearing and binder courses had continuous longitudinal, centerline joint cracking which averaged ½ inch wide with a range of 1/4 inch to 3/4 inch wide.

The sections with 5% fiberglass shingles had no measurable rutting, while the control sections did exhibit measurable rutting. At station 34+75, the westbound lanes with 5% shingles in the wearing and binder courses had 0 inch rutting in all wheel paths. The travel lane of the eastbound control section had ½ inch deep ruts in the right wheel path and 1/4 inch ruts in the left wheel path.

The section with 5% fiberglass shingles in both courses also exhibited slight transverse cracking. From stations 29+75 to 41+00, 5 transverse cracks were observed. Their lengths varied from 17 to 31 inches and their widths were less than 1/8 inch. Refer to photograph 6 to see the westbound travel lanes at Sta 36+90 which had shingles in the wearing and binder courses. Refer to photographs 7 and 8 to see westbound and eastbound travel and passing lane control sections without shingles.

PAVEMENT CORE TEST RESULTS

On June 19, 1997, almost six years later, nine pavement cores were taken. Six cores were taken at control sections, and three cores were taken of the ID-2 wearing and binder courses with 5% fiberglass roofing shingles. The test results of the control section cores at stations 27+11, 27+70, 28+08, 46+00, 47+84 and 48+00 are summarized on Table 8. The test results of the cores with 5% shingles in the wearing and binder courses at stations 37+98, 39+49, and 39+52 are summarized on Table 9.

The test results show that the test section with 5% shingles in the wearing and binder courses have significantly higher viscosities than the control samples. The average viscosity of the wearing course with 5% shingles was 61,265, and the average viscosity of the wearing course of the control sections was 7,146. The average viscosity of the binder course with 5% shingles was 17,510, and the average viscosity of the binder course of the control sections was 7,965.

The asphalt contents of all sections are very similar. The average asphalt content for the wearing courses without shingles was 6.2 % and the average with 5% shingles was 6.2%. The average asphalt content for the binder sections without shingles as 4.5% and the average for the sections with 5% shingles was 4.6%.

The test results of the control section cores at stations 27+11, 27+70, 28+08, 46+00, 47+84 and 48+00 are summarized on Tables 9, and 10. The test results of the cores with 5% shingles in the wearing and binder courses at stations 37+98, 39+49, and 39+52 are summarized on Table 11.

OTHER PAVING PROJECTS WITH ASPHALT SHINGLES

S.R. 4022, Erie County

In July 1998, the Department paved 0.8 miles of S.R. 4022 with 1,085 tons of ID-2 wearing course modified with reclaimed asphalt roofing shingles and 1.5 miles with conventional ID-2 wearing course. The project was located between S.R. 19 and S.R. 97 in Erie County in PennDOT District 1-0 as shown on the location map, Figure 4. The paving extended on the 20 foot wide road from segment 10, offset 0000 to segment 40, offset 3208. The ADT on S.R. 4022 was 1,267 with 9% trucks.

The project was originally scheduled for June, 1998, but the contractor had difficulty in providing ground shingles at the acceptable size and of acceptable quality. The original plant supplying the shingles could not shred them to an acceptable size. Some of the submitted shredded shingles contained pieces of wood, brick, and paper. After trying shredders at other GAF plants, acceptable ground shingles were supplied by GAF in Baltimore, Maryland

The ground shingles as used were approximately the size of a man's thumbnail, approximately ½ inch in size. Photograph 12 shows a shovel full of the acceptable shredded shingles, and a bag of rejected shingle pieces. The shingles completely homogenized with the asphalt mixture, and provided 0.4% asphalt to the mix. The rolled wearing course with shingles had only a minor surface accumulation of unmelted shingles as shown in photograph 13.

S.R. 325, Dauphin County

In June 1998, the Department paved 2.0 miles of S.R. 0325, Section 003, through Clarks Creek Valley in Dauphin County, with asphalt concrete containing shredded roofing shingles. This 24 foot wide, two lane road had an ADT of 986 with 4% trucks. The project was located on S.R. 325, east of Dauphin Borough in Dauphin County in PennDOT District 8-0 as shown on the location map, Figure 5.

For Copy of Figure 4 – Location Map District 1-0's Paving Project with Shredded Roofing Shingles on SR 4022, Erie County, Pa
Call the Bureau of Construction and Materials
Engineering Technology and Information Division at (717)783-3392

For Copy of Figure 5 – Location Map District 8-0's Paving Project with Shredded Roofing Shingles on SR 0325, Dauphin County, Pa
Call the Bureau of Construction and Materials
Engineering Technology and Information Division at (717)783-3392

This project consisted of placing 2,535 tons of ID-2 Wearing Course with 5% fiberglass shingles on S.R. 325, Clarks Valley Road from Segment 0200, Offset 2460 to Segment 0250, Offset 0978. The shingles on this project were manufacturing scrap from I.K.O. Industries of Wilmington, Delaware, shredded to 100% passing the ¾ inch sieve and provided an asphalt content of 0.3%. These shingles were larger and provided less to the asphalt content than the shingles used in the test project which were ½ inch in size and provided 1.0% of the asphalt content.

After paving of S.R. 325, the mix appeared rich in asphalt. Shingles approaching ¾ inch in diameter were visible in the surface of the bituminous concrete wearing course. Photograph 9 shows a ¾ inch piece of a shredded shingle taken out of the mix and Photograph 10 shows the surface of the compacted wearing course. One minor problem observed on this project occurred when the breakdown roller was in vibratory mode during placement. During the directional change between the first and second passes, some of the shingle material was picked up by the roller, as shown in Photograph 11.

CONCLUSIONS

1. The Department has determined that asphalt pavements that contain shredded manufacturer scrap roofing shingles are suitable for incorporating into an asphalt mixture. The five year evaluation of the test project near Allentown, provides evidence of very good pavement performance. The bituminous concrete mix was modified with shredded shingles at a rate of 5 % by weight with a maximum size of ½ inch. The shingles added 1% of the asphalt content to the mix. The pavement sections with asphalt shingles exhibited minimal traverse cracking and centerline joint cracking similar to the control section. While the control section had between ¼ and ½ inch wheel ruts, all three pavement sections with shingles had no measurable ruts.

2. As a result of the successful performance of the asphalt pavement with shingles, the Department issued a statewide Provisional Specification titled “Reclaimed Manufacturer Asphalt Roofing Shingles in Plant-Mixed Bituminous Concrete Courses” on March 15, 1999 by way of Strike-Off Letter 420-99-008. Copies of the letter and the provisional specification are included in the appendix of this report. The English units version of the Provisional Specification with CMS reference number S94(PS040300) is included on pages 37 and 38. The Metric units version of the Provisional Specification with CMS reference number of S96(PS040300) is included on pages 39 and 40.

3. This Provisional Specification was used in two other projects, one in Dauphin County on S.R. 325 and one in Erie County on S.R. 4022. Satisfactory mixes of bituminous concrete with asphalt shingles were designed and placed on each project. The Dauphin County project used shredded shingles with a maximum size of ¾ inch which contributed 0.3 % of the asphalt content. Shingles approaching ¾ inch in diameter were visible in the surface of

the bituminous concrete wearing course. Some of these shingle pieces were picked up by the breakdown roller between passes when in vibratory mode. The Erie County project used shredded shingles with a maximum size of ½ inch which contributed 0.4% to the asphalt content.

RECOMMENDATIONS

1. New manufacturer asphalt roofing shingle scrap including tab punch-outs can be successfully incorporated in bituminous concrete pavements if the shingles are shredded to 100% passing the 🖹 inch sieve. Therefore, new shingle scrap such as tabs or end cuttings can be effectively recycled in the asphalt mixes on PennDOT paving projects.

2. To fully take advantage of the potential to replace a portion of the asphalt and therefore, reduce mix costs, shingles should be shredded to 100% passing minus ½ inch sieve.

3. Quality control of the shingle supply from the supplier to the asphalt producer to the contractor is very important to insure that the shingles are a by-product of the manufacturing process, that they are not dried out from being out in the sun for an extended period, and that they are free of foreign materials such as brick and wood chips.

4. An effort should be made by Pennsylvania owned shingle producers to obtain shredding equipment to provide a consistent, well graded source of material.

5. Limit introduction of shingles to 5 % by weight of the mix.

REFERENCES

National Asphalt Pavement Association, “Uses of Waste Asphalt Shingles in HMA”, State of the Practice, 1997.

Waller, H. Fred, and Richard W. May, “Waste Material in Pavements”, ASTM Standardization News, August, 1993.

TABLES

For Copy of Tables 1-9
Call the Bureau of Construction and Materials
Engineering Technology and Information Division at (717)783-3392

PHOTOGRAPHS

Photo 1. Lehigh County, Saucon Valley Road
Pile of ground roofing shingle tabs.

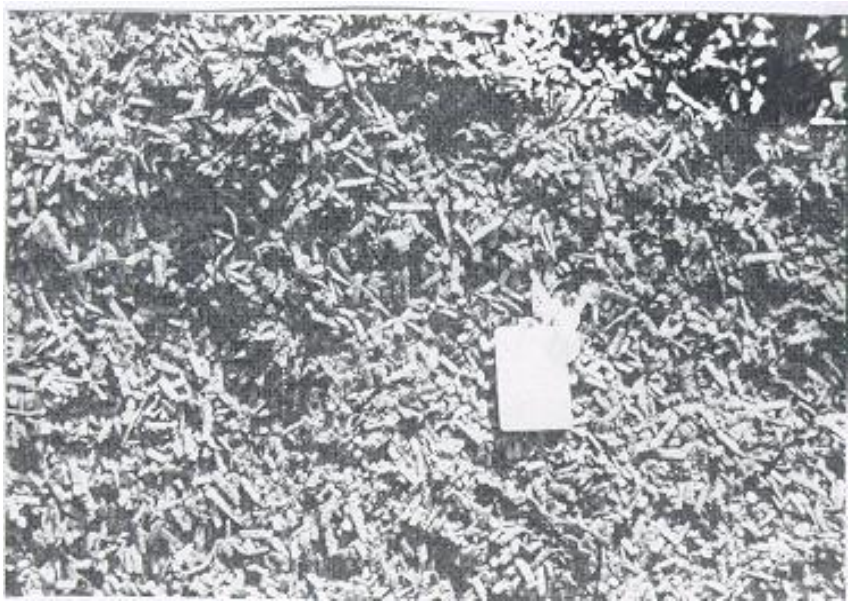

Photo 2. Lehigh County, Saucon Valley Road
Close-up view of the ground manufacturer shingle scrap.

Photo 3. Lehigh County, Saucon Valley Road
Close-up view of the bituminous concrete with fiberglass asphalt shingles in ID-2 wearing course at Sta 36+90 in 1994.

Photo 4. Lehigh County, Saucon Valley Road
Close-up view of the bituminous concrete with fiberglass asphalt shingles in ID-2 wearing course at Sta 36+90 in 1995.

Photo 5. Lehigh County, Saucon Valley Road
Westbound travel and passing lanes at Sta 36+90 looking west,
with shingles in both the wearing and binder courses on 8/17/95.

Photo 6. Lehigh County, Saucon Valley Road
Westbound travel and passing lanes at Sta 36+90 looking west,
with shingles in both the wearing and binder courses on 11/247/97.

Photo 7. Lehigh County, Saucon Valley Road
Westbound travel and passing lanes at Sta 27+50 looking west,
control section without shingles on 11/247/97.

Photo 8. Lehigh County, Saucon Valley Road
Westbound travel and passing lanes at Sta 34+00 looking east,
control section without shingles on 11/247/97.

Photo 9. Dauphin County S.R. 325
¾ Inch Shingle Piece

Photo 10. Dauphin County S.R. 325
Compacted Wearing Course with Shingles

Photo 11. Dauphin County S.R. 325
Shingle Material Picked Up By Roller

Photo 12. Erie County S.R. 4022
Shovel with Acceptable Shredded Shingles, Maximum ½ Inch
Bag with Rejected Shingle Pieces Larger Than ¾ Inch.

Photo 13. Erie County S.R. 4022
Rolled Wearing Course with Shingles

APPENDIX

"Provisional Specification for
Reclaimed Manufacturer Asphalt Roofing Shingles
In Plant-Mixed Bituminous Concrete Courses"

March 15, 1999 42099008

Provisional Specification for Reclaimed Manufacturer
Asphalt Roofing Shingles in Plant Mixed Bituminous
Concrete Courses

DISTRICT ENGINEERS/ADMINISTRATOR

Gary L. Hoffman, P.E., Chief Engineer /s/
Highway Administration

The Department recently completed a five-year evaluation of a test project which used hot mix asphalt with roofing shingle pieces in the wearing and binder courses. The paved sections of the test project in District 5-0, near Allentown, provided very good pavement performance by exhibiting minimal transverse and centerline joint cracking and no measurable rutting. As a result of this project, the Department researched other state specifications on using asphalt roofing shingles and prepared a draft provisional specification for the use of Reclaimed Manufacturer Asphalt Roofing Shingles in Plant-Mixed Bituminous Concrete Courses.

This draft provisional specification was used in the Summer of 1998 on two test projects: one in Dauphin County (District 8-0) on S.R. 325; the other in Erie County (District 1-0) on S.R. 4022. The shredded shingles were successfully incorporated into the asphalt mixes on both projects. The shingles provided 0.4% asphalt to the mix used in Dauphin County and 0.3% asphalt to the mix used in Erie County. A research project report on the District 5-0 project has been completed. The report includes an evaluation of the project and provides information on the District 1-0 and 8-0 projects.

The Provisional Specification for Reclaimed Manufacturer Asphalt Roofing Shingles in Plant-Mixed Concrete Courses is being issued in an English units version, with CMS document number S94(PS040300), and in a metric version, with CMS document number S96(PS040300).

The following guidelines govern the use of the Provisional Specification for Reclaimed Manufacturer Asphalt Roofing Shingles in Plant-Mixed Concrete Courses:

1. Use only asphalt shingle scraps reclaimed from shingle manufacturers such as tabs, punch-outs, and damaged new shingles. Post-consumer shingles or used roofing shingles are not to be used.

2. The maximum ground shingle size must be 100% passing the l/2 inch (12.5) sieve. This is necessary to ensure complete melting of the shingle pieces and a uniform introduction into the mix. The end result will be a homogeneous mix.

3. The Districts should evaluate whether shingles can be used cost-effectively on a project by project basis. The supply of scrap shingles at one or several manufacturers and the shipping costs could affect the decision to use them. Another important consideration is to have an asphalt plant with a RAP bin within hauling distance of the project. Having the shingles shredded by the manufacturer instead of by the asphalt mixing plant may substantially reduce the cost of the shredded shingles.

4. Asphalt mixes with roofing shingles should be bid as an alternate to regular paving.

5. The maximum ADT limit for use of bituminous concrete courses with asphalt roofing shingles has been selected as 5,000. This will remain in effect while the Department gains experience using the asphalt mixes with shingles on roads with an ADT ranging between 1,200 and 5,000. If the asphalt shingle mixes continue to perform well, the ADT limit be increased in the future.

If you have any questions, please call Andrew Reed, P.E., at (717) 783-3392 or Jerry Malasheskie, P.E., at (717) 787-2134.

Attachments

423: 02239901:ABR:ej

cc: R. W. Carmichael, FHWA
M. M. Ryan, P.E.
H. Heck, APC
R. Cominsky, P.E., PAPA
J. Sells, PACA
Highway Administration Bureau Directors
BCM Division Chiefs
M. A. Azab, P.E.
R. E. Weber
K. Thornton
Transportation Knowledge Center
Library Services

PROVISIONAL SPECIFICATION FOR RECLAIMED

MANUFACTURER ASPHALT ROOFING SHINGLES IN

PLANT-MIXED BITUMINOUS CONCRETE COURSES

1. DESCRIPTION - This work is the construction of plant-mixed, dense graded bituminous concrete using a combination of virgin and/or reclaimed aggregate material (RAM), and reclaimed manufacturer asphalt roofing shingle (RAS) materials. Use of reclaimed asphalt pavement (RAP) materials, consisting of cold milled or crushed hot-mix bituminous mixture is permitted. Construct these recycled bituminous concrete courses as specified in Sections 305, 401, 402, 420, 421 and 424 of the Specifications, except as modified or supplemented as follows. Obtain guidelines for hot-mix recycling from the MTD, if needed.

2. MATERIAL

(a) Reclaimed Manufacturer Asphalt Roofing Shingle (RAS) Material. Include a description of the plan to control RAS material in the quality control plan. Use RAS material obtained as a by-product of the roofing shingle manufacturing process. Do not use RAS material obtained from the re-roofing of commercial or residential buildings. Due to significant composition differences, keep fiberglass-backed and organic felt-backed RAS material separate. Do not use both fiberglass-backed and organic felt-backed RAS material in the same mixture. Obtain certification, as specified in section 106.03(b)3., from the roofing shingle manufacturer that the shingles are a by-product of the shingle manufacturing process and that the RAS material consists of roofing shingles which are either fiberglass-backed or organic-felt backed. Provide manufacturer's certification to the Engineer.

Process any RAS material that cannot be completely broken down in the mixing process (at least 100% passing through a 3/4 inch (19 mm) sieve). Provide RAS material so that the final mix complies with Section 305.2(c), Table A, or Section 401.2(d). Keep all RAS material free of foreign materials. Keep all RAS material free of moisture that affects the mixing process or performance of the mixture.

(b) Bituminous Materials for Recycled Mix Containing 16% or More RAP. After evaluation by the MTD of the asphalt cement in the pavement core and/or RAP material and RAS, the MTD will determine the class (grade) of asphalt cement and/or recycling agent to be used.

(c) Reclaimed Asphalt Pavement (RAP) Material. If used, have the RAP material comply with Section 403.2(b).

(d) Reclaimed Aggregate Material (RAM) If used, have the RAM meet the applicable quality requirements of Section 703.1, Table A or 703.2, Table B.

(e) Composition of Mixtures. As required by Section 305 or Section 401 and as follows, the bituminous mixture consists of the RAS material, virgin aggregates(s), and or RAM and asphalt cement and possibly RAP material. Bituminous mixtures which include RAP and/or RAM shall also comply with Section 403.2(d).

The RAS shall not exceed 5 percent by mass (weight) of the total mixture. Analyze the mix composition (asphalt content and gradation) of the RAS material stockpile. Obtain at least 10 samples from the stockpile at different locations and extract them to determine the average RAS mix composition. Maintain records of the testing of RAS composition and make available for review when directed. Determine the average stock gradations of virgin aggregate and/or RAM to be blended with the RAS material. Determine the proportions of the reclaimed and virgin materials to meet the specified mix composition requirements of virgin courses. Prepare and test Marshall specimens or Superpave Gyratory Compactor specimens as directed in Bulletin 27, Chapter 2, and have the job-mix formula reviewed.

3. CONSTRUCTION - Section 305.3 or 401.3 or 402.3 with additions and modifications as follows:

(b) **Bituminous Mixing Plant**. Add the following;

PLANT-MIXED BITUMINOUS CONCRETE COURSES

1. **Batch Plant**. Modify the batch plant to allow weighing the RAS and/or RAP material prior to incorporation into the pug mill. Design the cold feed bin, conveyor system, charging chute(s), and any special bins, if used, to avoid segregation and sticking of the RAS and/or RAP material. Dry the virgin aggregate and/or RAM and heat to a suitable temperature so that on combining with the RAS and/or RAP material the resulting complete mix temperature is within the limits of the bituminous material supplier's Bill of Lading. Insure that the virgin aggregate is free of unburned fuel oil when delivered to the plug mill.

2. **Drum Mixer Plant**. Modify the drum mixer plant to prevent direct contact of the RAS and/or RAP material with the burner flame and/or overheating of the RAS and/or RAP material in the process. Produce a completed mixture that is within the temperature limits of Table B in 401.2(d).

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