

Use of Reclaimed Asphalt Shingles in Illinois

A Report in Accordance with Public Act 097-0314

PHYSICAL RESEARCH REPORT NO. 162

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USE OF RECLAIMED ASPHALT SHINGLES IN ILLINOIS:

A REPORT IN ACCORDANCE WITH
PUBLIC ACT 097-0314

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ABSTRACT

When the term shingles is used, one thinks of the roofing material on a house. When asked what shingles could be used for, one again thinks of roofing a house. Shingles are primarily used for that purpose, but they can also be used for other purposes, such as replacing virgin materials used in mixtures for constructing pavements. The Illinois Department of Transportation (IDOT) has taken a look into and studied the use of shingles waste material called Reclaimed Asphalt Shingles (RAS).

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INTRODUCTION

In May 2011, the 97th Illinois General Assembly passed House Bill 1326, which amended the Environmental Protection Act. This bill was signed into law as Public Act 097-0314 (Appendix A) by Governor Pat Quinn on August 12, 2011. This act addressed the desire to collect shingles from the waste stream and recycle the material into Illinois Department of Transportation (IDOT) hot-mix asphalt (HMA) paving projects. With the signing of the Public Act came opportunities. A new industry was created, thus creating new jobs and reducing the amount of waste going to a landfill. Also, the potential for savings were realized on state highway projects. As crude oil prices rise, all efforts that reduce dependence on oil imports and such related cost in Illinois highway construction need to be undertaken.

As part of the law, IDOT was required to produce an annual report of all efforts to incorporate reclaimed asphalt shingles (RAS) into paving projects. This report is the first to fulfill this requirement and as such covers more details on the technical issues surrounding shingles than will subsequent reports.

In addition to 13 other recycled materials, IDOT has found RAS to perform favorably as a valuable supplement or substitute for conventional materials. IDOT prepares an annual report of these materials and other materials that are experimented with by other states. The most recent report is Physical Research Report (PRR) No. 161 *Utilization of Recycled and Reclaimed Materials in Illinois Highway Construction in 2011* [1].

BACKGROUND OF SHINGLES

Why Recycle Shingles?

Modern asphalt shingles consist of a base mat of fiberglass or cellulose (paper) fiber that is impregnated with asphalt. Colored aggregate is placed on the exposed areas of the top side for visual appeal and protection from the elements. On the back side of the shingle, a fine aggregate dust is placed to prevent shingles from sticking together while bundled. All of these components can be utilized in the production of HMA.

The fiberglass or cellulose fiber used as the base material of the shingle can provide a benefit to HMA. One particular type of HMA known as Stone Matrix Asphalt (SMA) uses fibers and fine aggregate dust as major components in the mix. The fibers and fine aggregate dust in RAS replace all of the traditional fibers and a share of aggregate dust needed in the SMA mixture.

Due to its economic value, the most desirable component of shingles is the asphalt. Typically, new shingles are manufactured with liquid asphalt making up approximately 20 percent of the total volume of the shingle. Figure 1 shows the process of reclaiming shingles into useable material for incorporation into HMA.

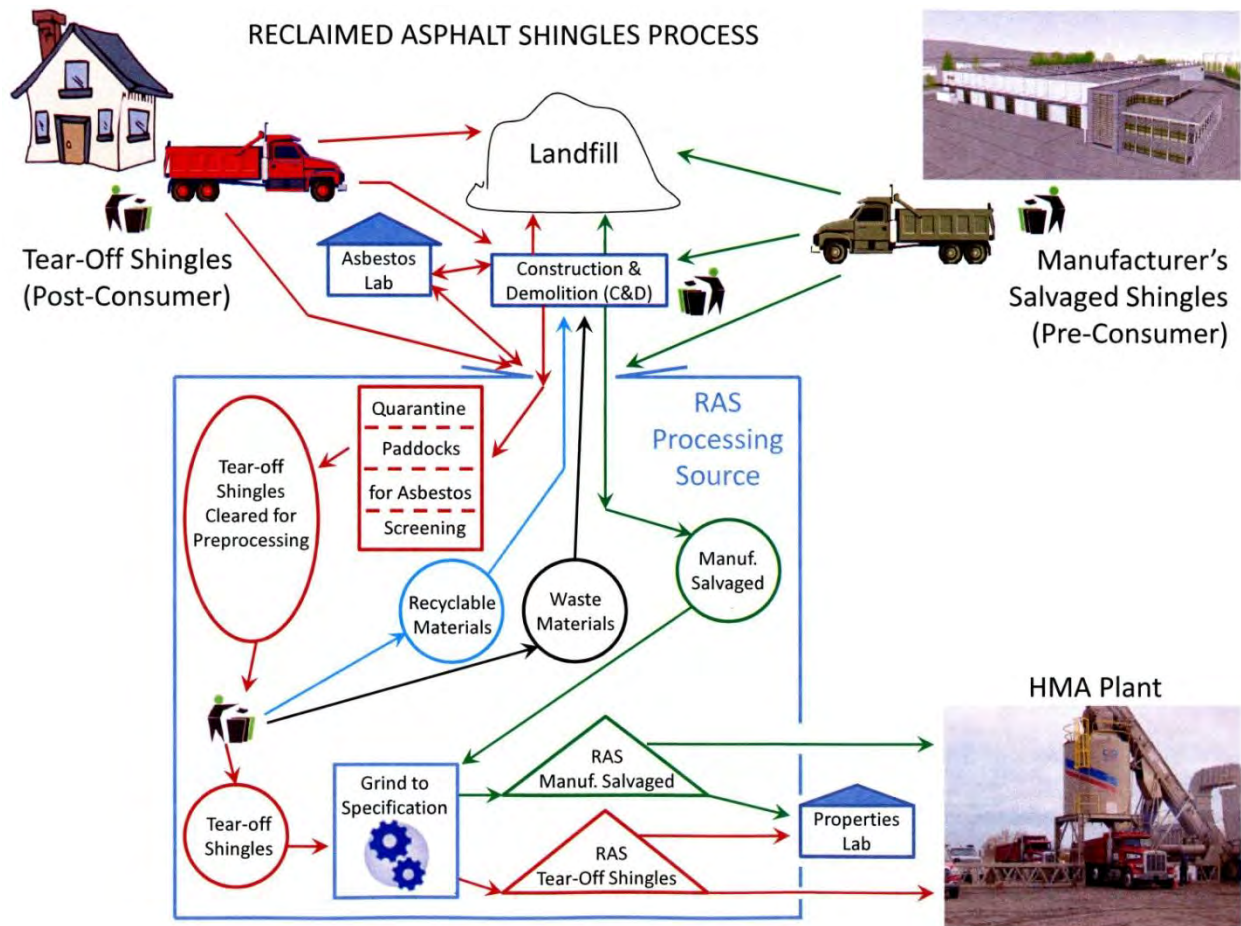


Figure 1. Diagram of Production Stream for RAS into HMA

Manufacturer's Salvaged (Pre-Consumer) Shingles

In the shingle manufacturing process, imperfections due to color variability, non-uniform coating, and other errors can result in the rejection of new shingles. Also, when producing traditional three tab shingles, the punched out tab is a waste product. These shingles and tabs can be collected and processed into RAS that can be used as an additive in the production of HMA. In order to do this the RAS must be ground and processed to approximately 0.25-inch or smaller material as shown in Figure 2. When used as an additive, the RAS can replace asphalt and aggregate in the HMA mixture with a cost savings.

The use of RAS from manufacturer's salvaged shingles has been allowed in IDOT HMA mixes for a number of years; however, the engineering of mix designs was not routine and generally cost prohibitive on a project-by-project basis. Prior to 2011, only one project was constructed using manufacturer's salvaged shingles. This was an overlay project on the Bishop Ford Expressway (I-94) in 2009.



Figure 2: Sample of Finely Ground 0.25-inch RAS Particles

Tear-Off (Post-Consumer) Shingles

In 2010, IDOT met with the Illinois Environmental Protection Agency (IEPA) to discuss adoption of RAS into HMA on IDOT projects. Post-Consumer or “Tear-Off” shingles are considered part of the waste stream and are designated to be disposed of at approved landfill facilities. To be diverted from the waste stream, a material must have a valid use and have an established condition of acceptance by a new owner who wishes to utilize the waste stream material. The process is termed Beneficial Use Determination (BUD). This process is outlined in Section 22.54 of the Illinois Environmental Protection Act (415 ILCS 5/22.54).

Figure 3 shows an 80,000-ton pile of post-consumer shingles in an approved recycling facility. As a frame of reference, the individual standing in front of the pile that is highlighted with a circle is a 5’-8” tall IDOT employee.

Prior to the early 1980s, some manufacturers may have used asbestos as a fiber for the base mat of the shingle. Asbestos was never actually banned from use; however, due to litigation, those using it went out of business from health claims and related costs. Today it is difficult to determine if shingles containing asbestos were ever marketed in Illinois, and if so, where. Because of this concern, National Emission Standards for Hazardous Air Pollutants (NESHAP) requires asbestos screening when shingles are removed from commercial buildings and on apartment complexes with four or more units. These requirements are most likely imposed to place the burden of asbestos testing on larger structure owners and not single-family homeowners. The primary shingle sources for tear-off RAS are non-commercial facilities, apartment houses of three units or less, and single-family homeowners that are not controlled by NESHAP.

To utilize tear-offs, IDOT contracted with Weston Solutions Inc. to investigate testing schemes for screening of asbestos in shingles [2]. The executive summary of the report about this investigation is included in Appendix B. Several testing firms are qualified to conduct testing for asbestos in shingles due to the NESHAP requirement. Most firms charge between \$5 and \$20 per test for this screening. The cost difference is mainly due to the turn-around time of results. While this is the cost for the actual test, there are other costs associated with the screening process, such as sampling, logging, and shipping these samples to the laboratory facility.



Figure 3: 80,000-ton Pile of Post-Consumer Shingles

All quantities for RAS are numbers that were reported to the Materials Integrated System for Test Information and Communication (MISTIC) for calendar year 2011. The MISTIC database provides materials quantities according to contracted use, testing, and inspection data. Every IDOT project in which RAS was incorporated into the mix is included in this report. In 2011, IDOT had a total of 23 contracts that utilized RAS in HMA mixtures, with a majority of them being located in the Chicago area. The total quantity of RAS used in these projects was 3,234 tons. Figure 4 shows the nine IDOT districts and the percentage of the total RAS used by the two districts that have constructed projects.

Though IDOT is fairly new in using RAS, the city of Chicago and the Illinois Tollway have more experience. In 2011, the city of Chicago and the Illinois Tollway used 4,440 and 14,054 tons of RAS, respectively. The Illinois Tollway's quantity was an increase of 12,278 tons from the previous year. Also, the Illinois Tollway expects another increase in RAS use in the upcoming years to accommodate the massive amount of anticipated HMA production. IDOT also intends to dramatically increase the number of paving projects incorporating RAS in the near future.

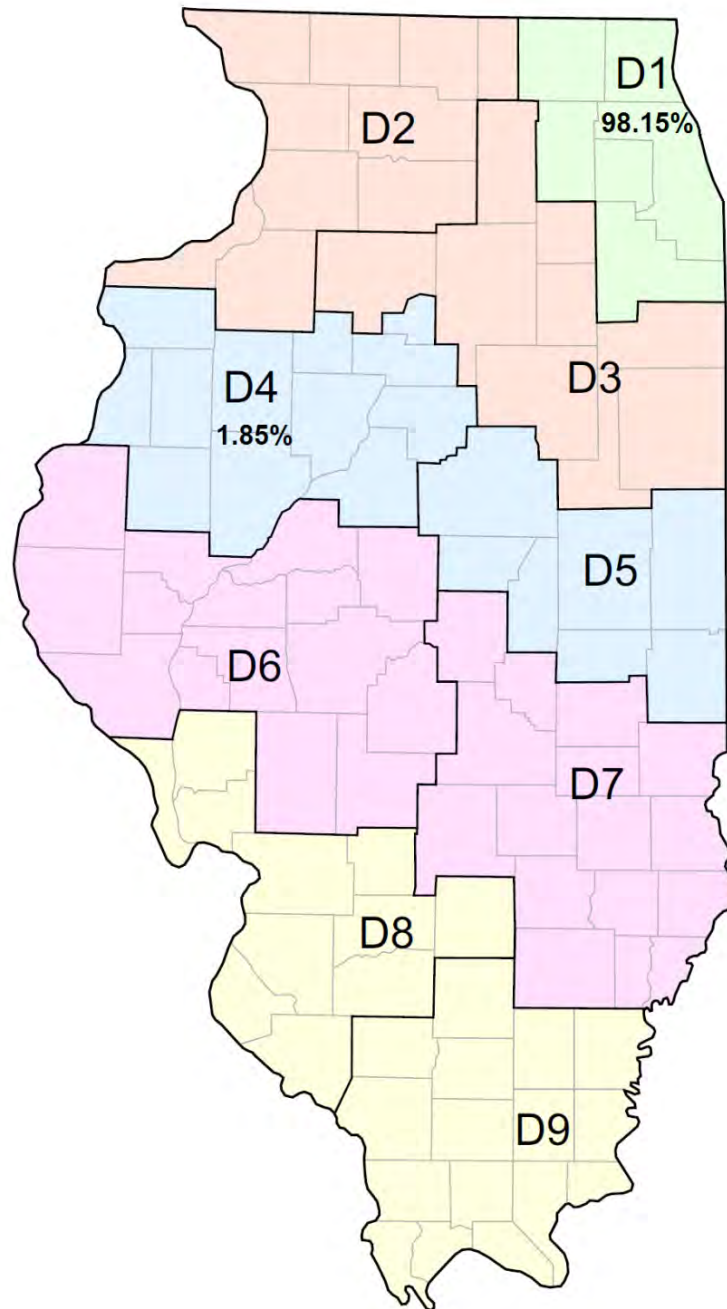


Figure 4: IDOT Districts and the Percentage of Total RAS Used in 2011

RECLAIMED ASPHALT SHINGLES IN HOT-MIX ASPHALT

There are limits as to how much RAS can effectively be added into most HMA mixtures before pavement properties are adversely impacted. Shingle asphalt has been specifically engineered and processed for use in a very high temperature application where long-term exposure to the sun is expected. For pavements, the HMA needs to perform in the heat of summer, but also withstand frigid winter conditions. Because of exposure to cold temperatures and related cracking, paving asphalts tend to be much softer than shingle asphalts. Appendix C contains the department’s RAS policy and Appendix D contains the RAS special provision.

For paving asphalts, a Performance Grading (PG) system has been developed that is used worldwide. In this grading system, temperature extremes for the roadway project location are used to select the asphalt grade that will provide the best performance. Appendix E contains the department’s Pavement Technology Advisory (PTA) D-4, *Performance Graded Binder Materials for Hot-Mix Asphalt*, which provides an explanation of the use of this grading system. For Illinois, PG64-22 is the grade primarily used for paving mixtures. Shingle asphalt obtained from an Illinois shingle manufacturer graded out as PG112 +2. Once in place on the roof for a number of years, shingle asphalt hardens and is not suitable for use in HMA in large quantities unless countered with softer paving asphalt grades. Figure 5 shows the comparison of temperature ranges for performance graded asphalt binders and shingle asphalt based upon the minimum and maximum temperatures. Figure 6 shows the percent usage of each asphalt binder grade on IDOT projects from 2007 to 2011.

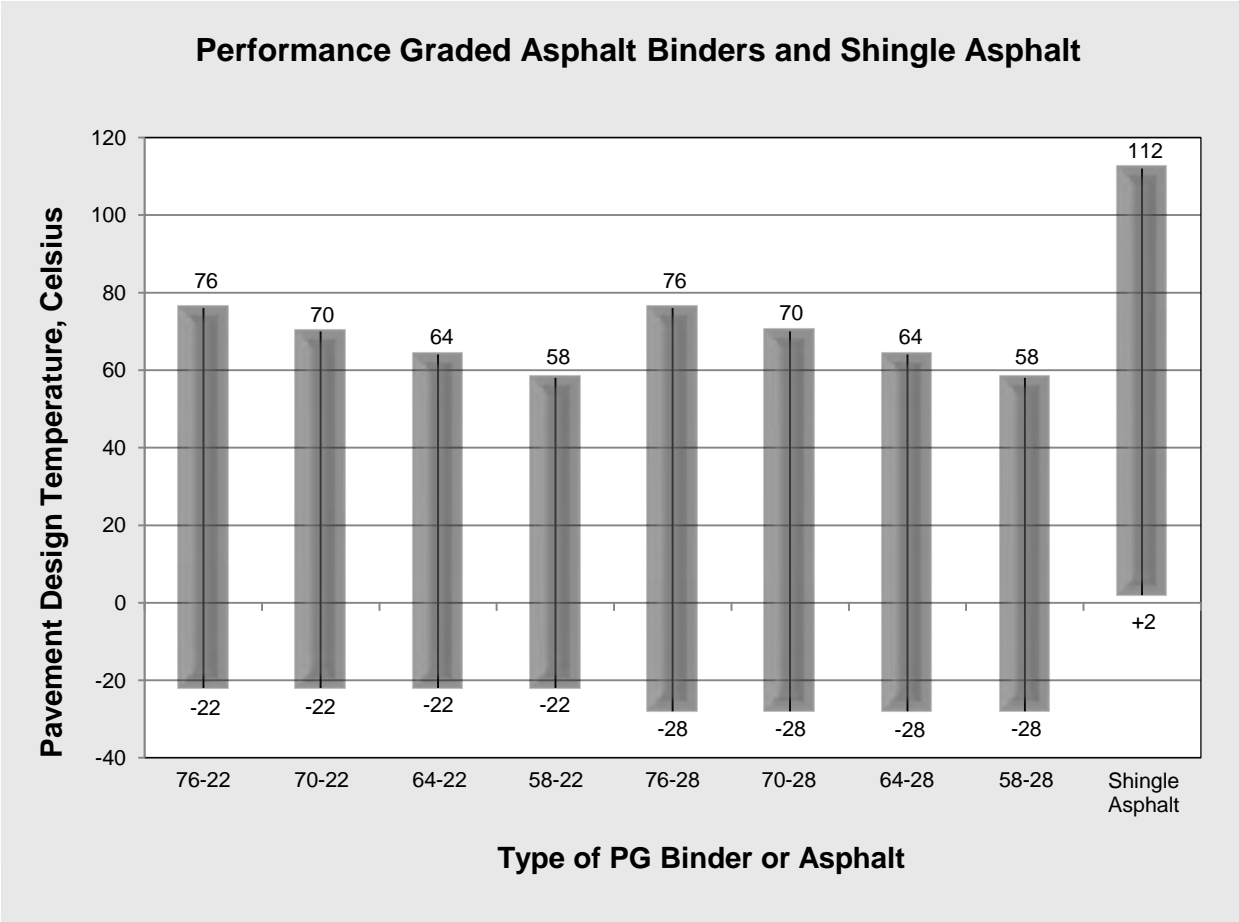


Figure 5: Temperature Ranges for Performance Graded Asphalt Binders and Shingle Asphalt

Asphalt Binder Grades Used in Illinois for HMA

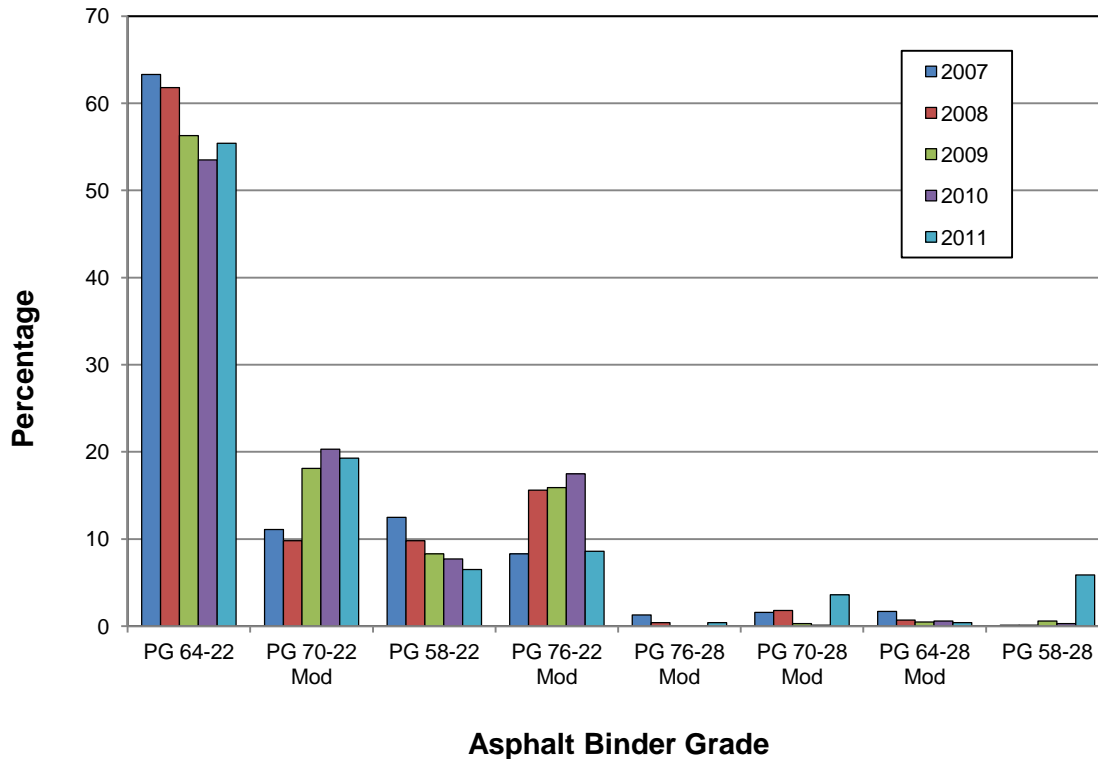


Figure 6: Percent of PG Asphalt Binder Grades Used on IDOT Projects During 2007-2011

POLICIES AND SPECIFICATIONS

Documents are developed and maintained by IDOT to regulate materials acceptance for and construction procedures on IDOT projects. These documents consist of policy memorandums and specifications which have been developed by the Bureau of Materials and Physical Research (BMPR).

Policy Memorandum for Reclaimed Asphalt Shingle (RAS) Sources

In order to allow the use of RAS in IDOT HMA mixtures, a policy had to be written to establish criteria for approving sources. The IDOT BMPR Policy Memorandum for Reclaimed Asphalt Shingle (RAS) Sources was first introduced in 2010. It outlines how companies supplying RAS need to operate in order to supply their product for use in IDOT construction projects. Increased recycling reduces the amount of material disposed in landfills and has the potential to benefit the state and the country overall. Already, the RAS Policy has undergone several revisions as sources and IDOT become more familiar with RAS and the necessary means to process it. The version used from April 1 through December 31, 2011 is shown in Appendix C.

A RAS source can process two different types of material. First, Type 1 is known as manufacturer's salvaged or pre-consumer waste. The second is Type 2, which is tear-offs or post-consumer waste. Most facilities right now deal with just one type or the other, but they

have the option to process both. If they decided to handle both product lines, the two types of shingles must be kept separate the entire time. Manufacturer's salvaged and tear-off shingles have different gradations and asphalt contents, so they must be kept separate to ensure a uniform final product. Manufacturer's salvaged shingles are taken in by the facility, stockpiled, ground, and then sold to HMA Contractors. The only tests required for this type of shingle are the gradation and asphalt content of the final product.

For tear-off shingles, there are several aspects that Illinois monitors: presence of asbestos, cleanliness, asphalt binder content, and final gradation of the processed shingles. The policy is very clear on the procedures to be followed in order to prevent asbestos from contaminating the final product. Typically, the shingles are presorted and roughly cleaned at the collection site or brought to the RAS processor by the homeowner. The loads of shingles coming into the processor are inspected by a certified asbestos inspector, quarantined, and tested for asbestos (two samples for every 250 tons). No shingles can be processed until the test results come back negative for any trace of asbestos. Once asbestos results come back negative, the shingles are then released from quarantine and cleaned again at the source so that there is no more than 0.5 percent unusable material in the final product. Next, the RAS is ground and sized to specifications. The ground shingles are tested every 250 tons for asphalt binder content and washed gradation. The final RAS has to meet IDOT-specified gradations to be used in HMA for constructing pavements.

Special Provisions for Reclaimed Asphalt Shingles (RAS)

Specifications provide Contractors with the construction requirements for IDOT projects. A project-specific form of a specification is known as a special provision. BMPR developed the initial special provision for incorporating RAS into HMA mixtures at the same time as the policy memorandum in 2010. This document also went through several revisions in the beginning of RAS use in IDOT projects. A copy of the January 1, 2011 special provision is included in Appendix D.

This document defines the requirements for all aspects of using RAS in HMA mixtures for IDOT construction projects. In addition to specifying material handling and testing, the special provision describes the percentage of RAS allowed in each HMA mixture and the equipment requirements for producing HMA. During 2011, the special provision allowed RAS to be used alone to replace a maximum of 5 percent by weight of total mix, or RAS could be used in conjunction with reclaimed asphalt pavement (RAP) up to a specified maximum binder replacement.

RECLAIMED ASPHALT SHINGLES STUDIES

Recycling is good for the environment; however, there is a possibility that recycled (reclaimed) materials may have detrimental effects on performance. IDOT has taken a closer look into the use of RAS in HMA mixtures and the impacts on performance through research projects that have been conducted by the Illinois Center for Transportation (ICT).

R27-SP17: A Study on Warm-Mix Asphalt

This special project conducted by the ICT began in June 2009 and the final report was published in June 2011 [3]. The study was initiated to characterize a number of new mixes, including SMA mixes containing RAS. A control mix with 0 percent RAS and a PG76-22 binder

was compared to mixes containing 5 percent RAS and two different binder grades: PG76-22 and PG70-22. The results of dynamic modulus testing showed that the RAS mixes had a lower dynamic modulus at low temperatures and high frequencies, although all mixes had similar dynamic modulus values at high temperatures and low frequencies. Testing with the Hamburg Wheel Track showed significantly more (25 percent) rutting for the RAS mixture with the PG76-22 binder as compared to the control mix. This result is at odds with the dynamic modulus testing and illustrates the need to fully assess the impact of RAS use on long-term pavement performance.

A serious concern with use of RAS in mixes is an increased likelihood of thermal cracking due to the aged and oxidized condition of the asphalt binder in the RAS. The R27-SP17 study did not evaluate the impact of the aged RAS binder on thermal cracking, but cautioned that additional testing needed to be done to determine the low temperature fracture properties of mixes containing RAS.

R27-SP19: Evaluation of the Effect of RAS on IDOT Asphalt Mixtures

This special project conducted by the ICT began in December 2011 and ended in June 2012. It was undertaken to evaluate the effect of RAS use on certain properties of asphalt mixtures, such as strength, permanent deformation, and fracture. Loose mix and field samples were collected to run Semi-Circular Bending beam (SCB) and Disc Compact Tension (DCT) tests to assess cold-weather fracture potential, and Hamburg Wheel Track testing to assess rutting potential. In addition, dynamic modulus and push-pull fatigue tests were conducted. The results of these tests were compared to tests run by the Texas Department of Transportation using their TXDOT overlay tester in order to measure reflective cracking resistance of the mixes.

Two different binder grades, PG58-28 and PG46-34, were used. These are not binder grades commonly used by IDOT, but were selected to balance the harder shingle asphalts. RAS percentages varied based on the binder used. The PG58-28 mix used 7.5 percent RAS and 10 percent fractionated reclaimed asphalt pavement (FRAP) by weight of total weight of the mix, while the PG46-34 mix varied the RAS content from 2.5 to 7.5 percent. The difference in RAS content was compensated by a corresponding revision to the FRAP content. The final report is expected to be published soon.

SUMMARY

To meet the requirements of Public Act 097-0314, this report will be updated and issued on an annual basis. The update will include the quantity of RAS allowed by department policy, the amount of its use in tons, and the number of projects including RAS in the mix.

Illinois is taking additional precautions and efforts to protect the environment. With the use of RAS in HMA projects, it will help establish a new market for recycled and reclaimed materials. IDOT plans to continue constructing projects that will include RAS in the future. IDOT is just in the beginning stages of implementing the RAS Policy but will be expanding use into other areas. A majority of Illinois projects using RAS are located in the Chicago area. IDOT hopes to expand use into other districts in the future.

IDOT's overall recycling efforts are contained in a separate report, PRR No. 161 *Utilization of Recycled and Reclaimed Materials in Illinois Highway Construction in 2011* [1]. As Illinois moves forward with its use of RAS, more studies will be conducted, more projects will be constructed with the material, and it is anticipated that the market will excel and create more opportunities, not just in Illinois but throughout the nation.

REFERENCES

- [1] Brownlee, Michael. Utilization of Recycled and Reclaimed Materials in Illinois Highway Construction in 2011. Physical Research Report No. 161, Bureau of Materials and Physical Research, Illinois Department of Transportation, Springfield, Illinois, July 2012.
- [2] Weston Solutions, Inc. Evaluation of Risks Associated with Incorporating Reclaimed Asphalt Shingles Potentially Containing Asbestos into Hot-Mix Asphalt. Work Order No. 02056.011.032, Weston Solutions, Inc., Vernon Hills, Illinois, February 2010.
- [3] Al-Qadi, Imad, Jeff Kern, and Jim Meister. A Study on Warm-Mix Asphalt. FHWA-ICT-085, Illinois Center for Transportation, University of Illinois at Urbana-Champaign, Urbana, Illinois, June 2011.

APPENDIX

A

AN ACT concerning safety.

**Be it enacted by the People of the State of Illinois,
represented in the General Assembly:**

Section 5. The Environmental Protection Act is amended by changing Section 22.38 as follows:

(415 ILCS 5/22.38)

Sec. 22.38. Facilities accepting exclusively general construction or demolition debris for transfer, storage, or treatment.

(a) Facilities accepting exclusively general construction or demolition debris for transfer, storage, or treatment shall be subject to local zoning, ordinance, and land use requirements. Those facilities shall be located in accordance with local zoning requirements or, in the absence of local zoning requirements, shall be located so that no part of the facility boundary is closer than 1,320 feet from the nearest property zoned for primarily residential use.

(b) An owner or operator of a facility accepting exclusively general construction or demolition debris for transfer, storage, or treatment shall:

(1) Within 48 hours of receipt of the general construction or demolition debris at the facility, sort the general construction or demolition debris to separate the

recyclable general construction or demolition debris and recovered wood that is processed for use as fuel from non-recyclable general construction or demolition debris to be disposed of or discarded.

(2) Transport off site for disposal all non-recyclable general construction or demolition debris that is neither recyclable general construction or demolition debris nor recovered wood that is processed for use as fuel in accordance with all applicable federal, State, and local requirements within 72 hours of its receipt at the facility.

(3) Limit the percentage of incoming non-recyclable general construction or demolition debris to 25% or less of the total incoming general construction or demolition debris, as calculated on a daily basis, so that 75% or more of the general construction or demolition debris accepted on a daily basis consists of recyclable general construction or demolition debris, recovered wood that is processed for use as fuel, or both.

(4) Transport all non-putrescible recyclable general construction or demolition debris for recycling or disposal within 6 months of its receipt at the facility.

(5) Within 45 days of its receipt at the facility, transport (i) all putrescible or combustible recyclable general construction or demolition debris (excluding recovered wood that is processed for use as fuel) for

recycling or disposal and (ii) all recovered wood that is processed for use as fuel to an intermediate processing facility for sizing, to a combustion facility for use as fuel, or to a disposal facility.

(6) Employ tagging and recordkeeping procedures to (i) demonstrate compliance with this Section and (ii) identify the source and transporter of material accepted by the facility.

(7) Control odor, noise, combustion of materials, disease vectors, dust, and litter.

(8) Control, manage, and dispose of any storm water runoff and leachate generated at the facility in accordance with applicable federal, State, and local requirements.

(9) Control access to the facility.

(10) Comply with all applicable federal, State, or local requirements for the handling, storage, transportation, or disposal of asbestos-containing material or other material accepted at the facility that is not general construction or demolition debris.

(11) Prior to August 24, 2009 (the effective date of Public Act 96-611), submit to the Agency at least 30 days prior to the initial acceptance of general construction or demolition debris at the facility, on forms provided by the Agency, the following information:

(A) the name, address, and telephone number of both the facility owner and operator;

(B) the street address and location of the facility;

(C) a description of facility operations;

(D) a description of the tagging and recordkeeping procedures the facility will employ to (i) demonstrate compliance with this Section and (ii) identify the source and transporter of any material accepted by the facility;

(E) the name and location of the disposal sites to be used for the disposal of any general construction or demolition debris received at the facility that must be disposed of;

(F) the name and location of an individual, facility, or business to which recyclable materials will be transported;

(G) the name and location of intermediate processing facilities or combustion facilities to which recovered wood that is processed for use as fuel will be transported; and

(H) other information as specified on the form provided by the Agency.

(12) On or after August 24, 2009 (the effective date of Public Act 96-611), obtain a permit issued by the Agency prior to the initial acceptance of general construction or demolition debris at the facility.

When any of the information contained or processes

described in the initial notification form submitted to the Agency changes, the owner and operator shall submit an updated form within 14 days of the change.

(c) For purposes of this Section, the term "recyclable general construction or demolition debris" means general construction or demolition debris that has been rendered reusable and is reused or that would otherwise be disposed of or discarded but is collected, separated, or processed and returned to the economic mainstream in the form of raw materials or products. "Recyclable general construction or demolition debris" does not include general construction or demolition debris processed for use as fuel, incinerated, burned, buried, or otherwise used as fill material.

(d) For purposes of this Section, "treatment" means processing designed to alter the physical nature of the general construction or demolition debris, including but not limited to size reduction, crushing, grinding, or homogenization, but does not include processing designed to change the chemical nature of the general construction or demolition debris.

(e) For purposes of this Section, "recovered wood that is processed for use as fuel" means wood that has been salvaged from general construction or demolition debris and processed for use as fuel, as authorized by the applicable state or federal environmental regulatory authority, and supplied only to intermediate processing facilities for sizing, or to combustion facilities for use as fuel, that have obtained all

necessary waste management and air permits for handling and combustion of the fuel.

(f) For purposes of this Section, "non-recyclable general construction or demolition debris" does not include "recovered wood that is processed for use as fuel".

(g) Recyclable general construction or demolition debris or recovered wood that is processed for use as fuel that is sent for disposal at the end of the applicable retention period shall not be considered as meeting the 75% diversion requirement for purposes of subdivision (b) (3) of this Section.

(h) For purposes of the 75% diversion requirement under subdivision (b) (3) of this Section, owners and operators of facilities accepting exclusively general construction or demolition debris for transfer, storage, or treatment may multiply by 2 the amount of accepted asphalt roofing shingles that are transferred to a facility for recycling in accordance with a beneficial use determination issued under Section 22.54 of this Act. The owner or operator of the facility accepting exclusively general construction or demolition debris for transfer, storage, or treatment must maintain receipts from the shingle recycling facility that document the amounts of asphalt roofing shingles transferred for recycling in accordance with the beneficial use determination. All receipts must be maintained for a minimum of 3 years and must be made available to the Agency for inspection and copying during normal business hours.

(Source: P.A. 96-235, eff. 8-11-09; 96-611, eff. 8-24-09; 96-1000, eff. 7-2-10.)

Section 10. The Illinois Highway Code is amended by adding Sections 4-221 and 4-222 as follows:

(605 ILCS 5/4-221 new)

Sec. 4-221. Mix designs. To the extent allowed by federal law, the Department specifications shall allow the use of recycled asphalt roofing shingles received from facilities authorized to process asphalt roofing shingles for recycling into asphalt pavement in accordance with (i) permits issued pursuant to Section 39 of the Environmental Protection Act or (ii) beneficial use determinations issued pursuant to Section 22.54 of the Environmental Protection Act. In creating the mix designs used for construction and maintenance of State highways, it shall be the goal of the Department, through its specifications, to maximize the percentage of recycled asphalt roofing shingles and binder replacement and to maximize the use of recycled aggregates and other lowest-cost constituents in the mix so long as there is no detrimental impact on life-cycle costs.

(605 ILCS 5/4-222 new)

Sec. 4-222. Recycled asphalt roofing shingles; cost savings; prohibitions on use in asphalt paving.

(a) It shall be the goal of the Department, with regard to its asphalt paving projects and to the extent possible, to reduce the carbon footprint and reduce average costs by maximizing the percentage use of recycled materials or lowest cost alternative materials and extending the paving season so long as there is no detrimental impact on life-cycle costs. In furtherance of these goals, the Department shall provide to the Chairpersons of the Transportation Committee in each legislative chamber, within 60 days after the completion of each fiscal year, a written report of the activities initiated or abandoned in each district or region within the Department to meet those goals during the previous year. The report shall also include an analysis of the cost savings directly or indirectly attributed to those activities within each district or region. Upon review of the annual report, the Transportation Committees in each chamber may conduct hearings and provide recommendations to the Department regarding the performance of each district or region.

(b) No producer of asphalt pavement, operating pursuant to an air permit issued by the Illinois Environmental Protection Agency, shall use recycled asphalt roofing shingles in its pavement product unless the shingles have been processed for recycling into asphalt pavement in accordance with (i) permits issued pursuant to Section 39 of the Environmental Protection Act or (ii) beneficial use determinations issued pursuant to Section 22.54 of the Environmental Protection Act. The

prohibition in this subsection (b) shall apply in addition to any other rules, specifications, or other requirements adopted by the Department regarding the use of asphalt roofing shingles in pavement product.

APPENDIX

B

Evaluation of Risks Associated with Incorporating Reclaimed Asphalt Shingles Potentially Containing Asbestos into Hot-Mix Asphalt

EXECUTIVE SUMMARY

Weston Solutions, Inc. (WESTON[®]) has prepared this evaluation of risks associated with incorporating reclaimed asphalt shingles (RAS) that potentially contain asbestos into hot-mix asphalt (HMA), at the request of the Illinois Department of Transportation (IDOT). Specifically, this evaluation details the effort taken by the Bureau of Materials and Physical Research (BMPR) to assess liabilities and health risks associated with using potentially asbestos containing RAS for roadway projects. A summary of tasks completed as part of this risk evaluation is presented below:

- 1) Conduct site visits at potential IDOT RAS sources and construction and demolition (C&D) supplier facilities to gain practical knowledge of operations and industrial standards.
- 2) Review the existing regulatory framework to identify potential jurisdictional limitations where asbestos management requirements might be conflicting or poorly understood.
- 3) Assess the regulatory, litigious, public image, and potential unknown risks related to the use of potential asbestos containing RAS and offer concrete strategies for managing these risk elements.
- 4) Develop a cost effective screening approach and develop recommendations to improve or replace the asbestos screening procedures outlined in the BMPR RAS Sources Policy Memorandum.

The conclusions of the evaluation indicate that litigation, health, and environmental risks associated with incorporating RAS that potentially contain asbestos in HMA are minimal and readily manageable. Furthermore, based on analytical results of RAS sampling conducted by IDOT and the RAS industry to date, it can be confirmed that the occurrence of RAS material containing asbestos in current RAS source waste streams is rare and the likelihood that either RAS or HMA material to become a regulated material is equally unlikely.

Statistical findings have determined that 2 tests per 250 tons of material would provide an appropriate level of confidence for screening asbestos in RAS and therefore, would be considered an acceptable approach for establishing RAS suppliers in new locations. Additional asbestos confirmation sampling of every positive asbestos result is recommended based on the known rate of false positive results associated with current asbestos analytical procedures. Applicable reports of the findings included in this evaluation are provided for further review as Appendices A through E.

APPENDIX

C

State of Illinois
Department of Transportation
Bureau of Materials and Physical Research
Springfield

POLICY MEMORANDUM

Revised: April 1, 2011

28-10.2

This Policy Memorandum supersedes number 28-10.1 dated March 23, 2011

TO: REGIONAL ENGINEERS AND HIGHWAY BUREAU CHIEFS

SUBJECT: RECLAIMED ASPHALT SHINGLE (RAS) SOURCES

DEFINITIONS:

Asbestos Containing Material (ACM) – Any material containing more than one percent (1%) asbestos as determined using the method specified in Appendix A, Subpart F, 40 CFR Part 763, Section 1, Polarized Light Microscopy.

Asbestos Free – Asbestos is not detectable using Polarized Light Microscopy.

Asphalt Shingles – A roof shingle mat of fibers impregnated with asphalt and covered with aggregate.

BUD (Beneficial Use Determination) – Written conditional exemption from Illinois EPA under the authority of Section 22.54 of the Illinois Environmental Protection Act (415 ILCS 5/22.54) that specifically exempts a Source that is providing Post Consumer shingles from Illinois EPA solid waste permit requirements.

Bureau – The Illinois Department of Transportation Bureau of Materials and Physical Research at 126 East Ash Street, Springfield, Illinois 62704-4766

C&D (Construction and Demolition) Debris – Waste including, without limitation, shingle materials from the construction, remodeling, repair, and demolition of structures.

Clean Loads – Sorted, pre-processed, Post-Consumer shingle material ready for processing under a BUD permit that contains not more than a cumulative total weight of 1.5% of felt attached to shingles, metal flashing, glass, rubber, paper, plastic, rolls or sheets of felt, or other unacceptable material excluding nails that are attached to shingles.

Department – Illinois Department of Transportation

District – The Illinois Department of Transportation District where the Source facility is located.

Extraction/Gradation Testing – Testing that must be performed by a Department prequalified Phase III Construction consultant laboratory, or in-house by a technician that has successfully completed the Department’s HMA Level I course and a Department approved lab.

Local Agency – Municipality, county or road district

Lot – A quantity of either Post-Consumer or Manufacturer’s Salvaged shingle material not greater than 1000 tons contained within a secured paddock.

Illinois EPA – Illinois Environmental Protection Agency

NESHAP – National Emission Standards for Hazardous Air Pollutants

Manufacturer’s Salvaged Shingles – Asphalt shingles, tabs, and end runs salvaged directly from a shingle manufacturer.

Mixed Loads – Loads of construction debris containing shingles supplied to a solid waste permitted site.

Paddock – A fenced-in or walled enclosure that can be locked and/or sealed to prevent undocumented removal or addition of new material. This area shall have a surface suitable to prevent soil from contaminating the RAS.

Pre-processed Shingles – Manufacturer’s Salvaged or Post Consumer shingles that remain to be ground to Department specifications.

Processed Shingles – Manufacturer’s Salvaged or Post-Consumer shingles meeting requirements herein that have been ground to Department specifications.

Polarized Light Microscopy (PLM) – Test method to identify asbestos following EPA 600/R-93/116. Laboratories shall be accredited through the National Institute of Standards and Technology (NIST).

Post-Consumer Shingles (*Tear-Off*) – Shingles salvaged from residential buildings of four or fewer dwelling units and/or single family dwellings not subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP). Shingles from whole house demolition will not be allowed.

Quality Control Plan – A document provided by the Source outlining proposed operational details to control the equipment, materials, and production methods to ensure the specified product is obtained.

Source – Recycler / Processor who processes shingles for use in Hot Mix Asphalt (HMA) and is authorized by the Illinois EPA and approved by the Department.

State – Illinois

Sublot – One truck load of preprocessed Manufacturer’s Salvaged or one “Clean” truck load of Post-Consumer, shingle material.

Supplier – Originating manufacturer of salvaged asphalt shingle or person/company supplying Clean Loads of Post-Consumer shingles to Sources. Recyclers cannot be Suppliers unless they are included in the Source's Bureau approved QC Plan and are authorized by the Illinois EPA.

Tipping Pad – Designated quarantine paddock for unloading incoming loads of shingles.

Training – An educational program specific to the job duties described in the quality control plan. The education program shall include how a specific position fits into the overall quality plan and the position responsibilities. For positions that require asbestos training, the education program shall be developed for the specific methods being used by the Source and presented by licensed specialist knowledgeable in the safe handling, usage and disposal of this material.

1.0 **PURPOSE**

- 1.1 To establish a procedure whereby the Reclaimed Asphalt Shingle (RAS) production of a Source may be conducted in accordance with applicable environmental laws and regulations in a manner that results in a product that may be accepted for use on State or Local Agency projects based on a uniform certified QC program. This policy shall be referenced with all applications for Illinois Environmental Protection Agency (Illinois EPA) permits (Bureaus of Air, Land and Water) or for applications of BUD permits required to operate a RAS processing facility.

2.0 **SCOPE**

- 2.1 This procedure shall apply to all Sources which desire to supply RAS for incorporation into HMA mixes for State and Local Agency projects.

3.0 **SOURCE RESPONSIBILITY**

- 3.1 Submit annually to the Bureau:
 - 3.1.1 A detailed QC Plan containing information specified herein to the Bureau for approval (Attachment 1).
 - 3.1.2 A certified statement that (see Attachment 2):
 - 3.1.2.1 All of the processed RAS from the Source is asbestos free.
 - 3.1.2.2 RAS furnished to State and Local Agency projects shall be processed and tested according to the Source QC Plan and be in compliance with the material requirements specified in the Department's RAS specification before shipment.
 - 3.1.2.3 Manufacturer's Salvaged shingles shall be transported, stockpiled, and processed separately from Post-Consumer shingles.
 - 3.1.2.4 For Post-Consumer shingles:

- 3.1.2.4.1 Only shingles that have been directly removed from residential buildings of four or fewer residential dwelling units and/or from single family dwellings not subject to NESHAP and that have been maintained separately from other C&D debris or waste will be accepted for processing.
- 3.1.2.4.2 Shingles shall be delivered only by trained haulers.
- 3.1.2.4.3 All incoming loads of Post-Consumer shingles shall be quarantined until all asbestos testing is completed and found to be asbestos free.
- 3.1.2.4.4 The entire quarantined stockpile shall be immediately removed from the premises if any test result indicates asbestos is present within the quarantined stockpile.
- 3.1.2.5 Certification shall include the Department's required wording regarding material approval, contractual status and performance standards. This certification shall be signed by a responsible officer of the Source with authority to bind the Source to the contract. This certification statement shall also be notarized.
- 3.2 The Source shall be responsible for on-site inspection costs associated with the initial Bureau and subsequent District inspections. The Source shall be responsible for travel expenses if it is located more than 50 miles outside the state line when inspections cannot be completed within one day's normal work hours of 8:00 A.M. to 4:30 P.M. The Source shall pay for transportation, per diem (meals), lodging and incidental travel costs incurred by the Department's inspector. The costs shall not exceed the limits established by the Department's travel regulations. At the Department's option, sampling arrangements may be made through a mutually approved private inspection agency.
- 3.3 The Source shall develop a tracking system to uniquely identify each Lot of material produced that associates production date(s), gradation, asphalt content and RAS type. Processed RAS shall be stored in paddocks that identify the current Lot and not intermingled with other Lots. The Lot number shall be identified on shipping tickets.
- 3.4 The Source shall provide to the HMA Producer written certification that the RAS has been produced in compliance with all State and Federal laws, statutes and this policy. The certification shall include Lot identifiers of the material supplied and whether it was classified as Post-Consumer or Manufacturer's Salvaged RAS. When processed Post-Consumer RAS is supplied, the HMA Producer shall also be provided with written certification from the Source that the Source has been issued all the necessary permits and authorizations from Illinois EPA and is operating in compliance with these authorizations.

- 3.5 The Source shall clearly identify each paddock of Manufacturer's Salvaged and Post-Consumer shingles, processed RAS from Manufacturer's Salvaged and Post-Consumer shingles, and storage areas for other recyclable materials (such as nails and aluminum trim) and waste as referenced in the QC Plan. The Source shall maintain each paddock to control the flow of material.
- 3.6 The Source shall post and maintain staff and Suppliers' training records that are immediately accessible to any state inspector during hours of operation.

4.0 **REQUIREMENTS FOR APPROVAL**

- 4.1 Potential Sources requesting Department approved status and Illinois EPA permitting for their facilities shall make application in writing to the Bureau. This application shall include:
- 4.1.1 An initial certified statement of compliance with the provisions contained in Article 3.1.2.
- 4.1.2 An acceptable QC Plan and history if applicable. The QC Plan will be reviewed by the Department and Illinois EPA.
- 4.2 When an acceptable QC Plan has been submitted, the Bureau will schedule an on-site inspection. If acceptable, the Bureau will provide notification to the Illinois EPA of the existence of a Source in conformance with this policy. The Bureau will place the Source on the Department's approved Source list for RAS and send an approval letter to the Source.
- 4.3 The Source will be responsible for submitting the appropriate permit or BUD application including QC Plan to the Illinois EPA. The Source shall provide to the Bureau proof that an Illinois EPA permit or BUD has been obtained within 90 days of receiving the Department's approval letter. Failure to provide a permit or BUD will result in removal from the approval list.
- 4.4 No shipment shall be made unless the Source has a valid permit or BUD from the Illinois EPA and is listed on the Department's approved Source list for RAS.

5.0 **ACCEPTANCE PROCEDURES**

- 5.1 RAS material at the HMA plant shall be identified by the bill of lading accompanying the shipment from the Source.

6.0 DOCUMENTATION

- 6.1 The Bureau will maintain a current list of approved RAS Sources from IDOT certified and Illinois EPA permitted Producers/Suppliers. The list will include the name of the Source, the Source code number, the location of the Source, and the Source's qualified products. The Bureau will update the list when the status of any Source changes. The approved certified processed RAS Source list is available on the Internet. To access, log onto the following IDOT website: <http://www.dot.il.gov>. The list is located under: Doing Business/Materials/Approved Lists for Materials.
- 6.2 HMA contractors receiving material from a Source whose certification has been revoked will be notified immediately by the Department's district office.
- 6.3 The HMA producer shall maintain for a period of three years bills of lading and material certification from the RAS Source.
- 6.4 The Source shall provide to the District weekly test results for asphalt binder content, maximum theoretical gravity and extracted gradation of the processed RAS.

7.0 ELEMENTS OF THE QUALITY CONTROL PLAN

- 7.1 The purpose of the QC Plan is to document the Source's process of control for recycling Manufacturer's Salvaged and Post-Consumer asphalt shingles into raw ingredient material that meets Department requirements for use in HMA applications.
- 7.2 The Source QC Plan shall contain the following (see Attachment 1):
- 7.2.1 The QC Plan shall declare all types of material that will be accepted at the facility. The allowable types are:
- Post-Consumer shingles.
 - Manufacturer's Salvaged shingles.
- 7.2.2 Detail the process for inspection of incoming loads of Manufacturer's Salvaged shingles. For Post-Consumer shingles, detail the process for inspection, sampling, testing and method of quarantine of incoming loads. Include the following:
- Source inspection personnel duties, responsibilities and training.
 - Describe criteria for accepting and rejecting loads from Suppliers.
 - Provide a plan view diagram showing flow of the processing operation with labels identifying the various components. See attachment X for a typical plan view diagram of a facility.
- 7.2.3 List training and qualification of staff and Suppliers. Records shall be kept of the dates of training and of the names of employees trained. Original certificates of training shall be available upon request.

- 7.2.4 The QC Plan shall identify the Source location, laboratory names and locations, and a complete description of the types and frequencies of the tests to be performed.
- 7.2.5 Identify method to be used to notify the HMA Producer's QC Manager in the event of decertification.
- 7.2.6 Attach an outline of required training for:
- Suppliers/Trained Haulers
 - Source asbestos inspectors for incoming loads
 - Source sorting personnel
- Training of the Source's staff and of the Supplier's personnel on acceptable and unacceptable materials shall be completed by the site certified asbestos inspector(s). Training materials shall be made available upon request.
- 7.2.7 Provide an Occupational Safety and Health Administration (OSHA) approved personnel protection plan for Source personnel as well as Department inspectors. Air monitoring of the equipment operators during the grinding of any Post-Consumer shingles shall be completed by a certified industrial hygienist (CIH). The QC Plan shall identify the air sampling procedures and frequencies for initial and periodic exposure assessment (personal breathing zone air sampling).
- 7.2.8 All approved addendums to the QC Plan in the preceding year shall be incorporated in the annual submittal. **[Note: Any changes to the QC Plan may require prior amendment of the BUD or a permit modification]**

8.0 OPERATION OF SOURCE FACILITY

- 8.1 Source sorting personnel shall attend a training session conducted by a certified asbestos inspector to learn to identify and remove unacceptable material prior to processing as outlined in the QC Plan.
- 8.2 All pre-processed shingles in quarantine pending test results and processed RAS shall be stored in confined paddocks to prevent mixing or contamination of the piles.
- 8.3 A sign shall be posted at the entrance to the Source facility indicating the name of the facility and hours of operation.
- 8.4 Access to the facility shall be controlled by a gated entrance and exit. The gate shall be locked when facility personnel are not present.
- 8.5 Facility security fencing shall be installed to prevent windblown material from leaving the facility.

- 8.6 Incoming loads shall only be accepted from a Trained Hauler/Supplier on the Source's list (see Attachment 3). Incoming loads shall be inspected for unacceptable materials (see Attachment 4) by a certified asbestos inspector familiar with the requirements and operation procedures of the facility and trained as required by the accepted QC Plan.
- 8.7 Unloading and storage of the Manufacturer's Salvaged and Post-Consumer shingles will each be separately confined to approved designated areas with all weather surfaces.
- 8.8 Manufacturer's Salvaged shingles shall be delivered with no unacceptable material (see Attachment 4).
- 8.9 Post-Consumer shingles shall be quarantined in a paddock until acceptable results from the asbestos testing are received.
- 8.10 Storage of the RAS shall be a minimum of 100 feet from waters of the U.S.
- 8.11 All materials potentially containing asbestos including caulks, cements, tars and other sealants shall be removed during the sorting process.
- 8.12 Storage time of sorted pre-processed shingles shall be minimized.
- 8.13 Clean loads consisting of sorted, preprocessed, Post-Consumer shingle material ready for processing shall not exceed a cumulative total weight of 1.5% of felt attached to shingles, metal flashing, glass, rubber, paper, plastic, rolls or sheets of felt, or other unacceptable material (Attachment 4). This total does not include nails that are attached to the shingles and removed for recycling in conjunction with the grinding process.
- 8.14 Unacceptable material separated from shingles shall be evaluated for each pre-processed Lot by weighing all of the unacceptable material collected per Lot and dividing it by the total Lot tonnage to determine percent unacceptable materials. Unacceptable material shall then be disposed of at a permitted disposal facility within 72 hours or transported off-site for recycling within 45 days unless a longer period is authorized by the regulatory agency. Records shall be kept to document compliance according to requirements specified herein.
- 8.15 Manufacturer's Salvaged and Post-Consumer shingles shall not be processed into the same stockpile.
- 8.16 Processing of sorted loads of Manufacturer's Salvaged and Post-Consumer shingles shall be conducted on-site with an industrial grinder. The industrial shingle grinder shall utilize water nozzles for dust control and to reduce the heat build-up during the grinding process as needed. The final ground product shall be reduced to a size that meets owner/agency specifications for use in HMA applications.

- 8.17 The final processed, Post-Consumer shingle product shall be free of visible nails and have at most 0.5% unacceptable material (see Attachment 4). Unacceptable materials shall not exceed a cumulative total of 0.5% by weight based on material retained on the 4.75 mm (No. 4) sieve.
- 8.18 Storage of the final processed RAS should be minimized. RAS stockpiles shall not exceed 5,000 tons (10,000 cubic yards) and shall be delivered to the end user within four months after processing unless a longer period is authorized by the regulatory agency. Records shall be kept to document compliance with this requirement.
- 8.19 Processed Post-Consumer and Manufacturer Salvaged RAS may individually be mechanically blended with 5 percent FA20 manufactured sand using Department approved calibrated feeders.
- 8.20 The following documentation shall be collected, maintained in bound or electronically imaged chronological files on site for a minimum of three years, and made available to the regulatory agency upon request:
- Original Supplier Certification Forms (Attachment 3) shall be compiled daily
 - Tonnage of Manufacturer's Salvaged and Post-Consumer shingles accepted shall be compiled monthly.
 - Tonnage of Post-Consumer shingles initially accepted but subsequently rejected and disposed of shall be compiled monthly.
 - Tonnages of processed RAS shall be compiled monthly.
 - Tonnages of preprocessed and processed Manufacturer's Salvaged and Post-Consumer shingles stored and retention times shall be compiled monthly.
 - Training records shall be compiled for each training session.
 - Copies of all environmental permits, BUDs and other authorizations issued by the Illinois EPA.
 - Records documenting unacceptable material storage times.
- 8.21 Copies of bills of lading shall accompany each load and be presented to the HMA plant for filing. The bills of lading shall contain the following information:
- Name and location of Source.
 - Lot number(s) from which material was drawn.
 - Sequence number identifying the shipment.
 - Consignee & destination.
 - Date of shipment.
 - Type of material. (Post consumer or Manufacturer's Salvaged RAS).
 - Gross, tare and net weights.
- 8.22 Regulatory agencies shall be allowed to conduct random inspections of the facilities during normal working hours as deemed necessary and as otherwise authorized by law including C&D facilities supplying shingles to the processor.
- 8.23 Any changes to the general operation of the Source facility as documented in the QC Plan will require Bureau approval and may require modification to the BUD or permit issued by the Illinois EPA prior to implementation.

9.0 **REVOCAION OF A SOURCE'S APPROVAL**

9.1 The Department may revoke a Source's approval for any of the following reasons:

9.1.1 An approved Source that fails to timely renew or to comply with the conditions of a permit, BUD or other authorization issued by the Illinois EPA or Department's criteria for approved status.

9.1.2 Unscheduled visits will be made to all Sources periodically by the Department. If an approved Source is not in compliance with certifications listed in 3.1.2 herein, or fails to follow the Bureau's RAS policy, specification or its approved QC Plan, the Source will be removed from the approved list.

9.2 The Source may re-apply for approval status at the end of the revocation period, which is one year, and a one year probationary period. Re-application shall be in writing to the Bureau and include the specific steps taken to correct the cause for loss of certification.



David L. Lippert, P.E.
Engineer of Materials
and Physical Research

Model QC Plan

Company Name: _____
 Address: _____
 Contact: _____

Source/Facility Address: _____
 Phone Number: _____
 Hours of Business: _____

Description: Include plan view drawing of facility as attachment & identify on drawing: 1) what areas are paved, 2) paddock contents, 3) means of containment (i.e. fence, wall, locked gate, other security devices etc....).

In space provided list facility area, paddock areas & wall height).

A. Personnel (list full name, and training received for each title listed):

Title	Name	Training Received
Certified Inspector		
Sorter		
Certified Asbestos Inspector*		

* - If not an employee, list company employed under name.

B. Suppliers (list full name, & company date approved for each approved delivery person):

Name	Company	Date Approved

C. Material to be processed: Post-Consumer, Manufacturer's Salvaged, or both. (Circle one):

(Attachment 1)

D. Outline Process for inspection, sampling & asbestos testing of incoming loads:

E. Laboratory Testing (name, location, contact person, phone number):

Testing (e.g. dry shake gradation, extraction gradation & AC content, contaminants, asbestos etc.). At a minimum, processed RAS shall be tested at least once every 250 tons to verify 100 percent of the RAS passes the 3/8 inch (9.5 mm) sieve and 93 percent passes the #4 (4.75 mm) sieve based on a dry shake gradation.

Test	Test Method	Frequency

F. Outline process for record keeping & storage documentation (i.e. paddock contents), include receiving & shipping dates & file storage location) and file location:

(Attachment 1)

G. Name of Landfill for all waste materials (include address & phone):

H. Detailed processing plan (include: equipment used, products made, use of storage, scales etc...). Provide a plan view diagram showing the flow of the processing operation with labels identifying the various components:

I. Example Bill of Lading (include as attachment)

J. Describe all personnel protection equipment needed for Department inspectors.

(Attachment 1)



The following individual certifications shall be initialed with a full signature at the bottom by a responsible officer of the Source with authority to bind the Source. This certification statement shall also be notarized.

**All Sources
must fill out
this section.**

Reclaimed Asphalt Shingles (RAS): *Please enter your initials into the following statements*

I, _____, certify that the RAS will be produced from shingles not classified as Asbestos Containing Material (ACM).

I, _____, certify that all RAS to be furnished to State and Local Agency projects will be sampled and tested according to the Source Quality Control Plan and be in compliance with the material requirements specified in the Department's RAS specification before shipment.

**NOTE: Only
fill out this
section if you
will be
processing
Post-
Consumer
Shingles.**

Post-Consumer Shingles: *Please enter your initials into the following statements.*

I, _____, certify that only Post-Consumer Shingles that (1) are not subject to the National Emissions Standards for Hazardous Air Pollutants (NESHAP), and (2) will be maintained separately from other C&D Debris or waste will be accepted for processing; any other type of shingle will be rejected and immediately removed from the premises.

I, _____, certify that all Post-Consumer Shingles will be managed and processed by trained personnel.

I, _____, certify that all shingle types will be sampled and tested for asbestos according to the Source Quality Control Plan.

I, _____, certify that all incoming loads of Post-Consumer Shingles will be quarantined until all asbestos testing is completed and found to be free of ACM.

I, _____, certify that all shingles within a quarantine Paddock will be immediately removed from the premises if any sample taken from within the quarantine Paddock qualifies as ACM.

**Responsible officer for the Source with authority to
bind the Source:**

Printed name

Signature

Date

Notary:

Signature

Date



**Supplier Certification Form for
Manufacturer's Salvaged and
Post-Consumer (Tear-Off) Asphalt Shingles**

PART I: Supplier Company	
<i>Please indicate which best describes the Supplier:</i>	
<input type="checkbox"/> <-Manufacturer <input type="checkbox"/> <- C&D <input type="checkbox"/> <-Roofing company	
Supplier name: _____	
Supplier phone: _____	
Supplier e-mail: _____	
Supplier address: _____	

PART II: Supplier Rep (unless same as PART I)	
Rep's name: _____	
Rep's title: _____	
Rep's phone: _____	
Rep's e-mail: _____	
Rep's address (if not same as Supplier main address): _____	

PART III: Shingle Verification *(Please check the following boxes as directed.)*

<p>Mark all that apply.</p> <hr style="border-top: 1px dashed black;"/> <p>Fill out if you selected "C&D" or "Roofing Company" in PART I.</p>	<p><i>I the undersigned certify that:</i></p> <p><input type="checkbox"/> I have completed all appropriate hauler training.</p> <p><input type="checkbox"/> All shingle material delivered is from an approved Supplier cited in the Source's Quality Control Plan.</p>
	<p><i>Please check ONLY ONE of the following options:</i></p> <p><input type="checkbox"/> (1): Asbestos test results are included, indicating all material is Asbestos Free.</p> <p><input type="checkbox"/> (2): Asbestos testing has been initiated but is not complete.</p>

PART IV: Address(es) where Shingle Scrap originated and # of layers present *(staple additional items on separate sheet).*

<p>1. _____</p> <p>_____</p> <p style="text-align: right;"># Sh. Layers: _____</p>	<p>2. _____</p> <p>_____</p> <p style="text-align: right;"># Sh. Layers: _____</p>
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PART V: To be completed by Trained Hauler

_____	_____	_____
Trained Hauler (Print name)	Trained Hauler (Signature)	Date

For Source Use Only: <i>One or two certified asbestos inspectors may fill out this section over time.</i>		
Load status: <input type="checkbox"/> <-Accepted <input type="checkbox"/> <-Rejected Reason for rejection: _____		
Delivery Vehicle License: _____		
_____	_____	_____
Certified asbestos inspector (Print name)	Certified asbestos inspector (Signature)	Date
Results of asbestos testing (attached): <input type="checkbox"/> <-Asbestos Free <input type="checkbox"/> <-Asbestos found		
_____	_____	_____
Certified asbestos inspector (Print name)	Certified asbestos inspector (Signature)	Date

**Suppliers List of Acceptable and Unacceptable Materials
For
Recycling of Post-Consumer Tear-off Asphalt Shingles**

“Acceptable” materials

Include these items:

- Shingles
- Felt attached to shingles
- Nails

All other materials are “Unacceptable”

Unacceptable materials include, without limitation:

- Asbestos and asbestos-containing materials
- Wood, ply wood and sheeting
- Wire
- Cans
- Metal flashing, gutter, etc
- Rolls of sheets of felt paper
- Plastic wrap, buckets
- Paper waste
- Garbage trash or other waste materials
- Flat roofing shingles
- Rubber membrane roofing systems
- Built-up asphalt roofing
- Caulk
- Sealant
- Rubber gaskets

(Attachment 4)

APPENDIX

D

RECLAIMED ASPHALT SHINGLES (RAS) (BMPR)

Effective: January 1, 2011

Description. Reclaimed asphalt shingles (RAS) meeting Type I or Type 2 requirements will be permitted in all HMA mixtures as specified herein for overlay applications only. RAS shall not be used in full depth HMA pavement. RAS shall be a clean and uniform material with a maximum of 0.5 percent unacceptable materials, as defined in Bureau of Materials and Physical Research Policy Memorandum *Reclaimed Asphalt Shingle (RAS) Sources*, by weight of RAS. All RAS used shall come from a BMPR approved processing facility where it shall be ground and processed to 100 percent passing the 3/8 in. sieve and 93 percent passing the #4 sieve based on a dry shake gradation. RAS shall be uniform in gradation and asphalt binder content and shall meet the testing requirements specified herein.

Definitions. RAS shall meet either Type I or Type 2 requirements as specified herein.

- (a) Type I. Type I RAS shall be processed, preconsumer asphalt shingles salvaged from the manufacture of residential asphalt roofing shingles.
- (b) Type 2. Type 2 RAS shall be processed post-consumer shingles only, salvaged from residential, or four unit or less dwellings not subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP).

Stockpiles. Type 1 and Type 2 RAS shall be stockpiled separately and shall not be intermingled. Each stockpile shall be signed indicating what type of RAS is present.

Unless otherwise approved by the Engineer, mechanically blending a maximum of 5.0 percent by weight of the aggregate blend in HMA design, manufactured sand (FM20 or FM 22) with the processed RAS will be permitted to improve workability. The sand shall be "B Quality" or better from an approved Aggregate Gradation Control System source. The sand shall be accounted for in the mix design and during HMA production.

Records identifying the shingle processing facility supplying the RAS, RAS type and lot number shall be maintained by project contract number and kept for a minimum of 3 years.

Testing. RAS shall be sampled and tested during stockpiling.

For testing during stockpiling, washed extraction, G_{mm} and testing for unacceptable materials shall be run at the minimum frequency of one sample per 200 tons (180 metric tons) for the first 1000 tons (900 metric tons) and one sample per 250 tons (450 metric tons) thereafter. A minimum of five tests are required for stockpiles less than 1000 tons (900 metric tons). Once a ≤ 1000 ton, five-test stockpile has been established it shall be sealed. Additional incoming RAS shall be stockpiled in a separate working pile and only added to the sealed stockpile when the test results of the working pile are complete and are found to meet the tolerances specified herein for the original sealed RAS stockpile.

Before testing, each field sample shall be split to obtain two samples. One of the two test samples from the final split shall be labeled and stored for Department use. The Contractor shall extract the other test sample according to Department procedures. The Engineer reserves the right to test any sample (split or Department-taken) to verify Contractor test results.

Evaluation of Test Results. All of the test results, with the exception of percent unacceptable materials, shall be compiled and averaged for asphalt binder content, gradation and G_{mm} . Individual test results, when compared to the averages, will be accepted if within the tolerances listed below.

Parameter	RAS
No. 8 (2.36 mm)	± 5 %
No. 16 (1.18 mm)	± 5 %
No. 30 (600 μm)	± 4%
No. 200 (75 μm)	± 2.0 %
Asphalt Binder Content	± 1.5 %
G_{mm}	± 0.04

If more than 20 percent of the individual sieves are out of the gradation tolerances, or if more than 20 percent of the asphalt binder content, or G_{mm} test results fall outside the specified tolerance, or if the percent unacceptable materials exceeds 0.5 percent by weight of material retained on the #4 sieve, the RAS shall not be used in Department projects. All test data and acceptance ranges shall be sent to the District for evaluation.

Use of RAS in HMA. Type 1 or Type 2 RAS may be used alone in all HMA mixtures up to a maximum of 5.0 percent by weight of total mix or in conjunction with Reclaimed Asphalt Pavement (RAP). The maximum RAS or RAS/RAP blend usage will be dictated by the maximum binder replacement listed below.

HMA Mixtures ^{1/, 2/, /3, 4/}	Maximum Binder Replacement		
	Binder/Leveling Binder	Surface	Polymer Modified
Ndesign			
30	35	35	10
50	30	25	10
70	25	20	10
90	20	15	10
105	10	10	10

1/ For HMA shoulder and stabilized subbase (HMA) N-30, the maximum binder replacement shall be 50 percent.

2/ For SMA the maximum binder replacement shall be 20 percent.

3/ For IL 4.75 the maximum binder replacement shall be 30 percent.

- 4/ When the binder replacement exceeds 20 percent, the high and low virgin asphalt binder grades shall each be reduced by one grade (i.e. 25 percent RAP would require a virgin asphalt binder grade of PG64-22 to be reduced to a PG58-28).

HMA Mix Designs. RAS and RAS/RAP designs shall be submitted for volumetric verification. Type 1 and Type 2 RAS are not interchangeable in a mix design.

HMA Production. RAS shall be incorporated into the HMA mixture either by a separate weight depletion system or by using the RAP weigh belt. Either feed system shall be interlocked with the aggregate feed or weigh system to maintain correct proportions for all rates of production and batch sizes. The portion of RAS shall be controlled accurately to within ± 0.5 percent of the amount of RAS utilized. When using the weight depletion system, flow indicators or sensing devices shall be provided and interlocked with the plant controls such that mixture production is halted when RAS flow is interrupted.

When producing HMA containing RAS, a positive dust control system shall be utilized.

HMA plants utilizing RAS shall be capable of automatically recording and printing the following information.

(a) Dryer Drum Plants.

- (1) Date, month, year, and time to the nearest minute for each print.
- (2) HMA mix number assigned by the Department.
- (3) Accumulated weight of dry aggregate (combined or individual) in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).
- (4) Accumulated dry weight of RAS in tons (metric tons) to the nearest 0.1 ton (0.1 metric ton).
- (5) Accumulated mineral filler in revolutions, tons (metric tons), etc. to the nearest 0.1 unit.
- (6) Accumulated asphalt binder in gallons (liters), tons (metric tons), etc. to the nearest 0.1 unit.
- (7) Residual asphalt binder in the RAS material as a percent of the total mix to the nearest 0.1 percent.
- (8) Aggregate and RAS moisture compensators in percent as set on the control panel. (Required when accumulated or individual aggregate and RAS are printed in wet condition.)

(b) Batch Plants.

- (1) Date, month, year, and time to the nearest minute for each print.
- (2) HMA mix number assigned by the Department.
- (3) Individual virgin aggregate hot bin batch weights to the nearest pound (kilogram).
- (4) Mineral filler weight to the nearest pound (kilogram).
- (5) RAS weight to the nearest pound (kilogram).
- (6) Virgin asphalt binder weight to the nearest pound (kilogram).
- (7) Residual asphalt binder in the RAS material as a percent of the total mix to the nearest 0.1 percent.

The printouts shall be maintained in a file at the plant for a minimum of one year or as directed by the Engineer and shall be made available upon request. The printing system will be inspected by the Engineer prior to production and verified at the beginning of each construction season thereafter.”

APPENDIX

E

**PAVEMENT TECHNOLOGY ADVISORY
- PERFORMANCE GRADED BINDER MATERIALS
FOR HOT MIX ASPHALT -
PTA-D4**



INTRODUCTION

In 1999, the Illinois Department of Transportation (IDOT) began implementing the Superpave (Superior Performing Asphalt Pavements) mix design system, developed by the Strategic Highway Research Program. The Superpave method includes new terminology and procedures. The two most significant changes involve what used to be called asphalt cement. This is the material that holds hot mix asphalt (HMA) pavement together.

First, the term “binder” has been adopted to describe both modified and unmodified asphalt cement materials. One should note, however, that the intermediate paving course(s) of HMA pavements have traditionally been called “binders” or “binder courses,” as well. Usually the context makes it apparent which is being referred to, but it can be a source of confusion. Eventually, a term such as “intermediate layer” should be adopted to replace the term “binder (course)” in the IDOT vocabulary.

Second, Superpave uses a performance graded (PG) system of classifying binder materials. The PG system has its own nomenclature that is much different than the previous asphalt cement (AC) grading system. The remainder of this document will focus on clarifying the differences between the AC and PG grading systems.

AC GRADING SYSTEM

Until Superpave introduced the PG grading system, asphalt cements were either “penetration” or “viscosity” graded. IDOT used the “penetration” system until the mid-1970’s. From that time up to the conversion to Superpave, IDOT used a “viscosity” AC grading system.

One problem with the AC system is that it is based on empirical tests. Empirical specifications rely solely on practical experience and observations without regard for pavement performance theory. Therefore, the specification is based on the results from a given situation. Once the conditions change, the results may no longer be the same. The penetration test is a measure of asphalt stiffness, but the stiffness requirements were gained through experience. If the conditions change, the stiffness requirements may no longer be accurate. The accuracy will not be known until results are obtained under the new conditions.

Another drawback of the AC graded system is that long-term asphalt aging is not taken into consideration. The tests are performed on unaged or “tank” asphalt and on artificially short-term aged asphalt to simulate construction aging. No tests are performed to simulate in-service aging, which occurs when the asphalt reacts with the oxygen in the atmosphere by oxidation.

Oxidation increases the stiffness of the asphalt, making it more brittle or hard, causing premature cracking. Since oxidation occurs more rapidly at higher temperatures, warmer climates are more susceptible to greater amounts of in-service aging.

The AC system's tests do not cover the temperature extremes that a pavement endures. Binders that produce similar results at the temperatures used for penetration and viscosity testing may have very different results at other temperatures experienced by the pavement. For example, the three binders shown below (I, II, III) all meet the same AC grade specification; therefore, each may erroneously be expected to have the same characteristics during construction and the same performance during hot and cold weather conditions.

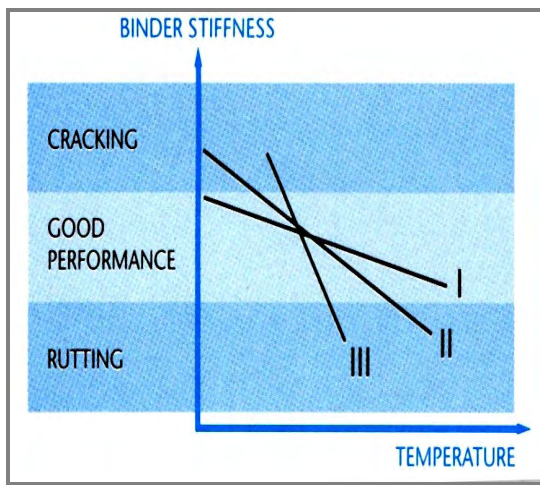


Figure 1: Temperature Responses of Different Binder Materials

CHANGING TIMES

Penetration and viscosity tests were developed in an era of significantly lower pavement loading. In the past, truck weights were around 72,000 lbs. with tires at 75 psi. Today, truck weights exceed 80,000 lbs. with 125 psi radial tires.

The 10% increase in truck weights yields a 40% increase in the stresses applied to the pavement, not to mention the increase in the number of trucks on the road. With such changes in road conditions, past experience is no longer sufficient to establish asphalt grading.

PERFORMANCE DRIVEN BINDERS

As part of the Superpave research, a new asphalt binder specification was devised. Grading based on viscosity and penetration has been replaced with a performance graded (PG) system. No longer are the tests empirical. The PG specification uses tests to measure physical properties that can be directly related to field performance by engineering principles.

PG binders are tested under conditions that are similar to the three critical stages of a binder's life. The binder is tested for the first stage of transport, storage, and handling. A rolling thin film oven is used to process the binder for the second stage, mix production and construction, by exposing binder films to heat and air that approximate exposure during mixing and laydown conditions. For the third stage, long term aging, the binder is aged using a pressure aging vessel. The pressure aging vessel exposes samples to heat and pressure to simulate years of in-service aging of a pavement.

WHAT DOES PG 64-22 MEAN?

PG means "performance graded" and may or may not contain polymers. The PG grade is selected largely based on the temperature where it is to be used. The nomenclature is illustrated in Figure 2. The first number (64 in the illustration) represents the maximum 7 day pavement design temperature in degrees Celsius (°C) for which the binder is tested.

The higher the first number, the warmer the climate. The second number (-22 in the illustration) represents the minimum temperature in Celsius for which low temperature cracking should not occur. The low number is not relevant to PCC overlays, since low temperature contraction of an underlying concrete pavement cannot be restricted by the strength of the HMA overlay. Both numbers change in 6 °C (11 °F) increments in the Superpave system. Thus the grade in Figure 2 would be for a pavement with an operating temperature range between 64 °C and -22 °C (147 °F to -8 °F).

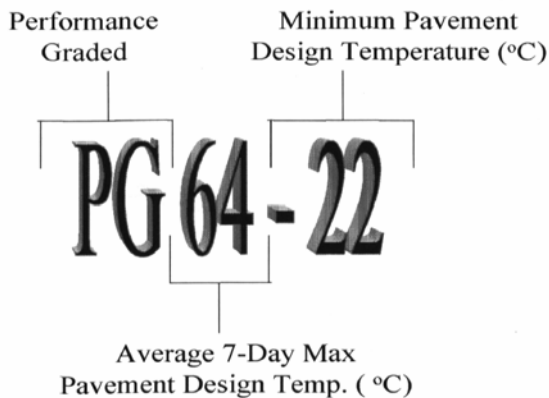


Figure 2: PG System Nomenclature

MODIFIED PG BINDERS

Some PG binders may require modifiers, such as polymers, to meet low and high temperature requirements (see [PTA-D5](#)). Although modifiers may affect many properties, the majority of modifiers attempt to decrease the temperature dependency and oxidation hardening of asphalt mixtures. A rule of thumb to determine whether a given grade will typically require some type of modifier is based on the working temperature range. For example, a PG 64-22 has a working range of 86 °C [64 + 22 = 86].

Higher quality crude oils can achieve a maximum working temperature of approximately 92 °C; whereas average crude oils have a maximum working temperature of approximately 90 °C.

IDOT allows any PG grade with a temperature differential of 86 °C or greater to be polymer-modified. Further, IDOT recommends polymer-modification for any PG grade with a temperature differential of 92 °C or greater. To assure that a polymer-modified PG binder is delivered by the supplier, the mix designer should specify a PG binder grade with the prefix "SBS" (e.g. SBS PG 64-28).

Unmodified PG binders should cost about the same as comparable AC grades (see the Grade Translation Chart on the following page), but modified binders can increase the cost of an HMA mixture by \$2 to \$5 per ton. As such, modified binders should not be prescribed without careful consideration of the benefits and costs associated with their use. Appropriate binder selection can be confirmed with the District Materials Engineer.

CERTIFICATION PROGRAM

PG binder materials and suppliers must be certified by the Bureau of Materials and Physical Research (BMPR) to be allowed on IDOT projects. A list of [Certified Sources for Performance-Graded Asphalt Binder](#) is available on the IDOT internet site.

If you have any questions about PG binder materials for hot mix asphalt, please contact:

Chief Chemist
Bureau of Materials and
Physical Research
126 East Ash Street
Springfield, IL 62704-4766
(217) 782-7200

GRADE TRANSLATION CHART

GUIDELINES FOR USE			
PG GRADE	EQUIVALENT	USE	WHERE
PG 64-22	AC 20	Overlays Full Depth Pavements	Statewide Dist. 1-9
SBS PG 70-22	AC 20 MOD	Overlays Full Depth Pavements	Statewide Dist. 7-9
SBS PG 76-22	AC 20 HD	Overlays Full Depth Pavements	Statewide Dist. 7-9
SBS PG 64-28	AC 10 MOD	Full Depth Pavements	Dist. 1-6
SBS PG 70-28	AC 10 HD	Full Depth Pavements	Dist. 1-6
SBS PG 76-28	AC 10 HD+	Full Depth Pavements	Dist. 1-6
PG 58-22	AC 10	Local Agencies	
PG 58-28	AC 7.5	RAP mixes	
PG 52-28	AC 5	Local Agencies RAP mixes	
PG 46-28	AC 2.5	Local Agencies	

Note: This chart is intended as a guideline only and does not constitute an IDOT policy. Binder grades other than those listed do exist, and new grades continue to be developed. Contact the District Materials Engineer for help in determining the most appropriate binder grade for a given application.