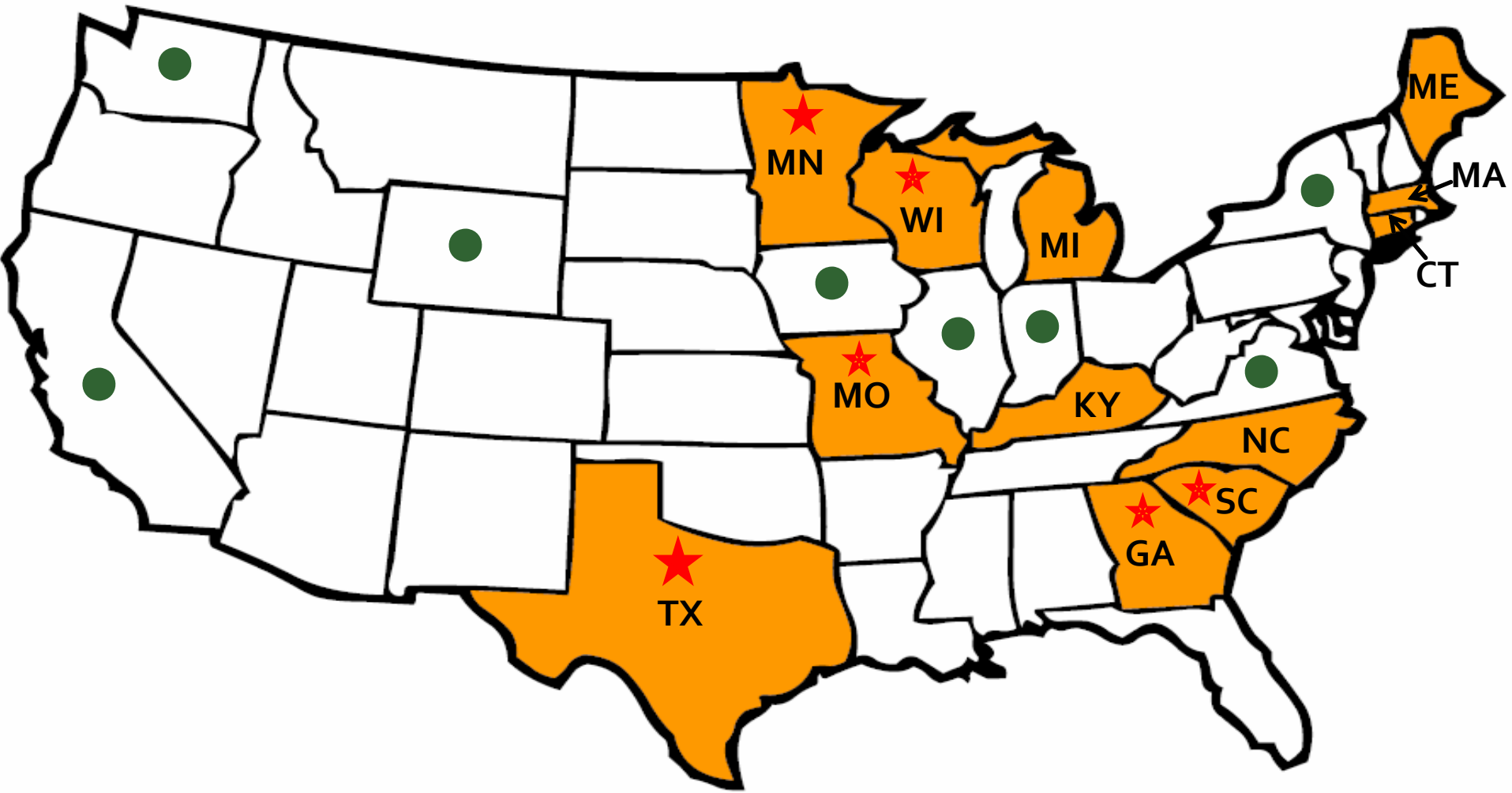
Development of Recycling Exemptions and Hot Mix Asphalt Specifications for Utilizing Recycled Post-Consumer Asphalt Shingles

R. Christopher Williams and Debra Haugen

Overview

- States Recycling Post–Consumer Asphalt Shingles
- Economic Drivers
- Environmental Drivers
- Intra-Government Communications
- Why Recycling Exemptions?
- Development of Exemptions – Key Points
- Development of End User Specifications
- Summary

States Recycling Post-Consumer Asphalt Shingles



Economic Drivers

- Crude oil prices have ranged from $45 to $140 over the last year!
- Post-consumer asphalt shingles contain up to 30% asphalt with an average of 20-22% available for replacement of the virgin asphalt in hot-mix asphalt pavement applications.
- Tipping fees for loads of asphalt shingles range from $15 - $120 across the US.

Environmental Drivers

- Landfill Diversion
  - Over 8 million tons of post-consumer asphalt shingles are landfilled in the US every year.
- Reduced Green House Gas (GHG) Emissions
  - 1,600,000 tons of available asphalt which is equivalent to 8,880,000 barrels of asphalt.
  - Potential reduction of 145,632 tons of GHG Emissions through the replacement of virgin asphalt that would otherwise be produced by refineries producing the asphalt.

Inter-Government Communication

- Determine asbestos sampling protocol
- Ensure a quality end product:
  - Shingles are sorted/cleaned to meet the required DOT deleterious limits
  - Final ground product is homogenous, sized to meet DOT specification, and free of ferrous and non-ferrous materials (nails).
- HMA plant modifications and permitting

Why Recycling Exemptions?

- Single stream recycled product
- Accepted loads of shingles contain less than 10% by weight of non-shingle material
- Most non-shingle material is recyclable (i.e. plastics, wood, metal)
- Growing End Markets:
  - HMA Pavements
  - Dust Control
  - Cold Patch
  - Fuel for Cement Kilns

Development of Exemptions

Standard Operation Plan
11 Key Points

1) Limit loads of post-consumer shingles to residential buildings with four or fewer dwelling units *(these buildings are not "regulated facilities" according to state and federal **NESHAP 40 CFR Part 61, Subpart M**)*.

Development of Exemptions

2) Have a trained asbestos inspector accept all incoming loads of asphalt shingles
   a. Loads containing unacceptable materials or visible asbestos containing materials are rejected
3) Train your suppliers on acceptable and unacceptable materials
   a. Create Brochures
   b. Offer Training Sessions
   c. Work closely with local landfills and transfer stations
   d. Offer additional discounts in tipping fee's for clean loads

Development of Exemptions

Unacceptable Materials

Neighborhood Garbage

Cement shingles

Cedar shake shingles

Flat Roof Asphalt Shingles

Built-up Asphalt Roofing

Deve ns

3) Sup n forms on t sphalt shin

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Supply Certification Form

Post Consumer or "Tear-Off" Asphalt Shingles

Delivery Company Name: _____

Address: _____

_____

Contact: _____

Phone: _____

E-mail: _____

We the undersigned, certify that:

1. All *Post Consumer or "Tear-Off"* asphalt shingle scrap came from residential buildings having four or fewer dwelling units (see addresses below or attached);
2. These residential buildings are not "regulated facilities" according to state and federal NESHAP 40 CFR Part 61, Subpart M.; and
3. The roofing waste material delivered consists of asphalt shingles and normal roofing debris only and contains no known hazardous material (e.g., asbestos).

Residential re-roof customer address (es) where the *Post Consumer or "Tear-Off"* asphalt shingle scrap originated:

_____

_____

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

Name and address of processor where the *Post Consumer or "Tear-Off"* asphalt shingle scrap was supplied to:

_____

_____

_____

_____ _____

***Post Consumer or "Tear-Off"* asphalt shingles supplier (signature)** **Date**

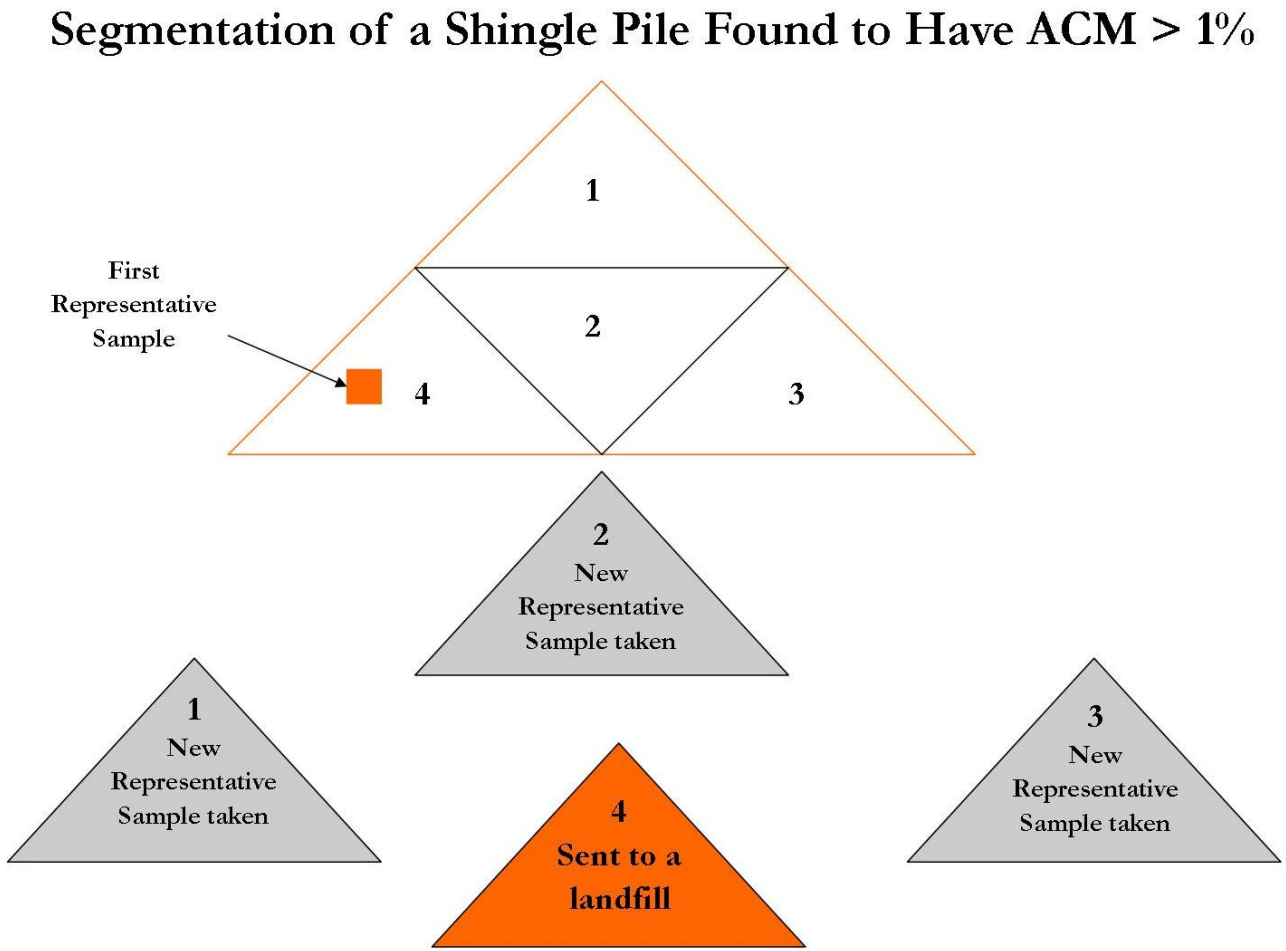
Development of Exemptions

4) Asbestos Sampling Protocol:
   a. Representative samples are collected for the first 100 incoming loads (approximately 1000 tons).
   b. Loads are stockpiled separately and labeled until the test results are known.
   c. If the sample results are negative (no ACM found), a reduced sampling protocol is implemented:
      i. Collection of representative samples may drop to every 250 tons or more

Development of Exemptions

d. In the event that a sample tests positive for ACM:
   i. Sampling continues for an additional *100* loads.
   ii. The "hot" pile is then segmented into 4 new piles and representative samples are taken from each of the new piles for testing. Segmentation will continue until all test results are negative (no ACM). All piles found to contain >1% ACM will be landfilled as non-friable asbestos containing material *(NESHAP Appendix A to 40 CFR Subpart M of Part 61 –Interpretive Rule Governing Roof Removal Operations)*.

Development of Exemptions



Development of Exemptions

e. Analysis of the Sampling Results
   i. Review test results for the 200 samples;
   ii. Create a statistically based sampling protocol; and
   iii. Implement new sampling protocol

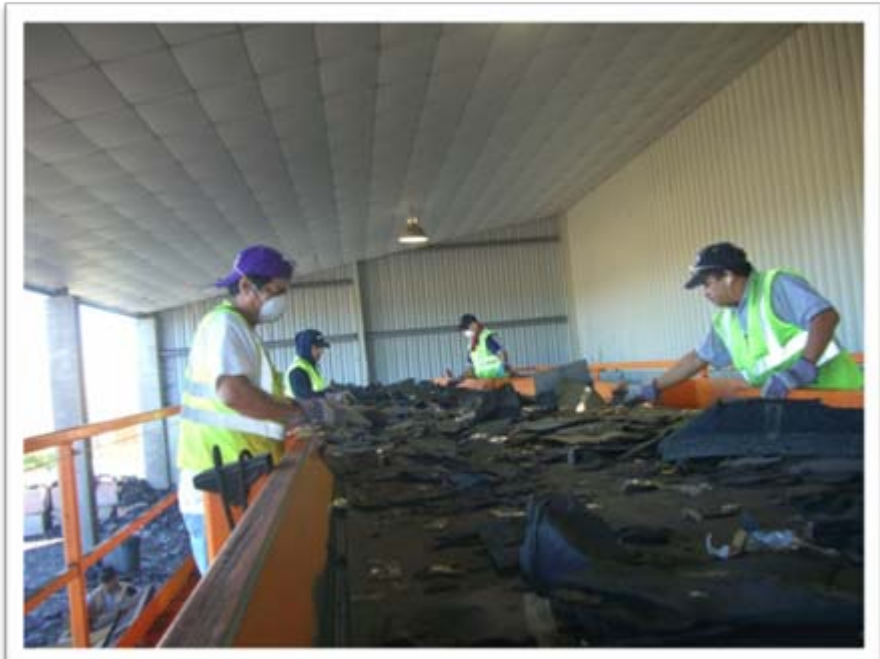
Development of Exemptions

5) Locate the shingle recycling operation at least 100 feet from surface waters
6) Store pre-ground shingles on a concrete pad
7) Fence the storage area to keep any debris from blowing into the clean ground shingle pile
8) Secure your end-market:
    a. Recycling facilities are required to move anywhere from 50% to 75% of the incoming product within a 6-12 month period

Development of Exemptions

9) Remove all non-shingle material

   a. Train your sorting staff on the removal of acceptable and unacceptable material. *Pre-ground product must have no more than 3% non-shingle material by weight.*



Development of Exemptions

Remove wood, felt paper, insulation and paper

Development of Exemptions

Remove plastic, metal flashing, cups and cans…

…and shingles
found with mastic

Development of Exemptions

10) Post-Consumer Shingle Processing
    a. Remove all nails!
        i. Nails are removed with magnets during the grinding process
        ii. The final ground product must contain no more than 1.5% non-shingle (deleterious) material

Pulley Magnet

Development of Exemptions

b. Final grind size needs to be less than 1/2 inch
c. Store the final ground product on a concrete (preferred) or bituminous pad

Development of Exemptions

11) Onsite Record Keeping
    a. Reference to the guidance document;
    b. Description of the asbestos testing program and specific sampling and testing methods;
    c. Monthly Documentation:
        i. Test results of the pre-processed *Post -consumer* asphalt shingles;
        ii. Supply certification forms on the sourcing of the *Post -consumer* asphalt shingles;
        iii. Tonnage of the *Post-consumer* asphalt shingles accepted;
        iv. Tonnages of loads of *Post-consumer* asphalt shingles rejected; and
        v. Tonnages of the *Post -consumer* asphalt shingles processed .

Development of DOT Specifications

- DOT deleterious limits vary from 0.5 -3%
- General DOT Final Grind Size:
  - **Non-surface mixtures:** 100% of the particles pass the ½ inch (12.5 mm) sieve and 90% of the particles pass the 3/8 inch (9.5 mm); and
  - **Surface mixtures:** 100% of the particles pass the 3/8 inch sieve and 95-100% of the particles pass the No. 4 (4.75 mm) sieve.

Development of DOT Specifications

- Do not blend post-manufactured RAS and post-consumer RAS for use in HMA mixtures.
- RAS may be used as a substitute for up to 5% of recycled asphalt pavement (RAP) or fractionated RAP (FRAP).
- Many states require that in all mixes containing recycled product, the virgin binder content must be greater than 65-70% of the total binder used.
- Certification Forms

Summary

- Prepare ***Draft*** Guidance Documents for Environmental Offices to use as templates
- Support communication between DOT & Environmental Engineers
- Understand the end-user requirements
- Certify loads and requirements to meet DOT specifications
- Share the Economic Benefits – can we see this get back to the homeowner?!

National Pooled Fund Study

Performance of Recycled Asphalt Shingles in Hot Mix Asphalt

Lead State: Missouri DOT

RESEARCH OBJECTIVES:

1. To identify design and QA/QC criteria in the sourcing, processing and incorporation of RAS to achieve a product that would exceed requirements for use in state HMA applications.
2. To conduct demonstration projects. This will include laboratory performance testing and field surveys to determine the performance of RAS in HMA at varying percentages, climates and traffic levels.
3. To create a comprehensive database on the performance of RAS in HMA applications.

Mix Design Approaches for Integration of RAS into HMA

Development of Mixture Design

- Process is no different than current methods of asphalt mix design development.
- Need to pay attention to integration of RAS into batching materials
  - Proportioned materials should be pre-blended prior to placement into oven.
  - Ensures even distribution of RAS throughout aggregate structure.

Outcomes of Mix Design

- Virgin binder content will be lower when RAS is utilized.
- 60-80% of RAS binder will be integrated into HMA mix.
- Voids in the Mineral Aggregate will increase with RAS utilization.
- Contribution of RAS binder to overall binder grade will not be known……but!

Challenges

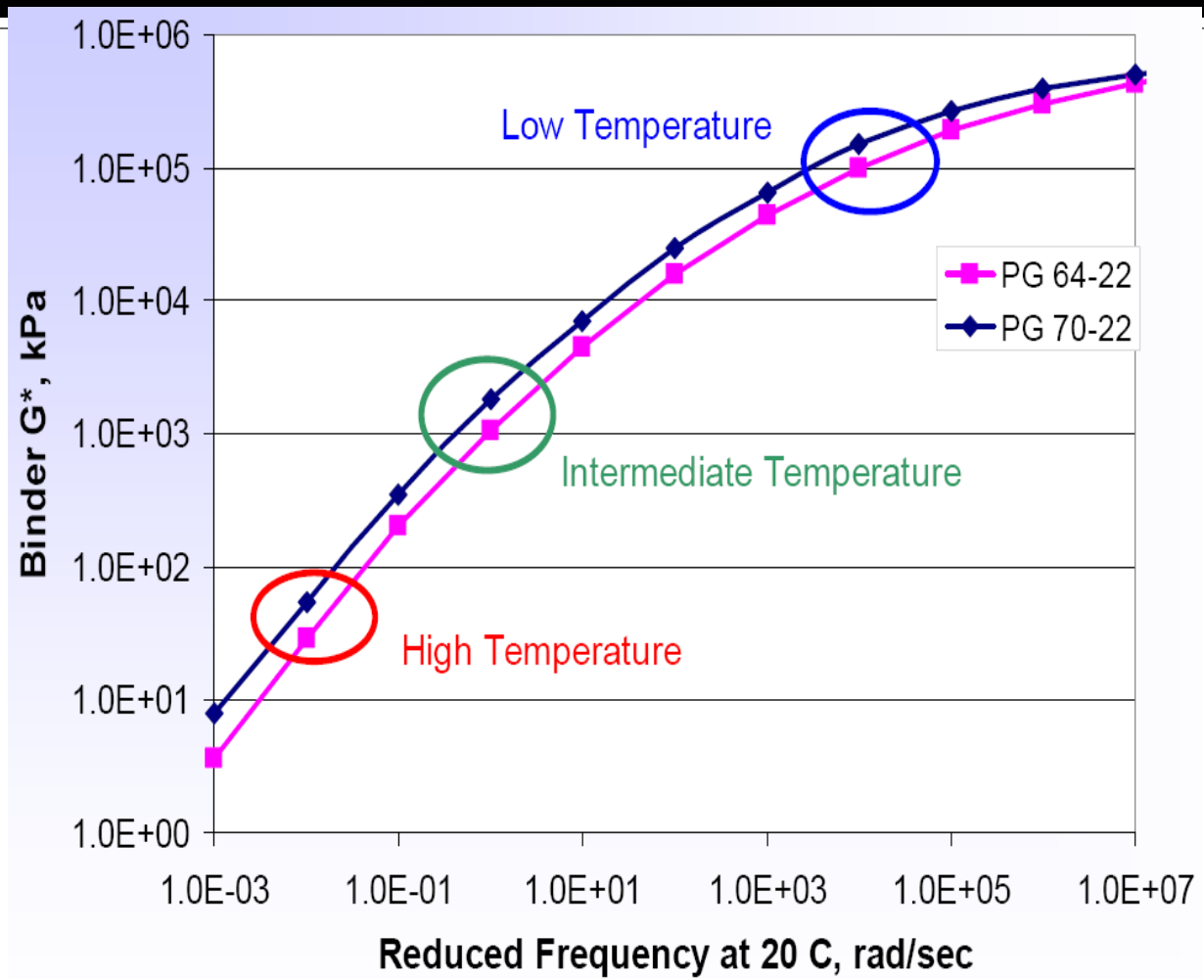
- AASHTO M323 binder recommendations assume complete mixing of new and recycled binder
- AASHTO M323 does not address RAS binders
- RAS rheology is different than paving binders

RAS Contribution to Performance Grade

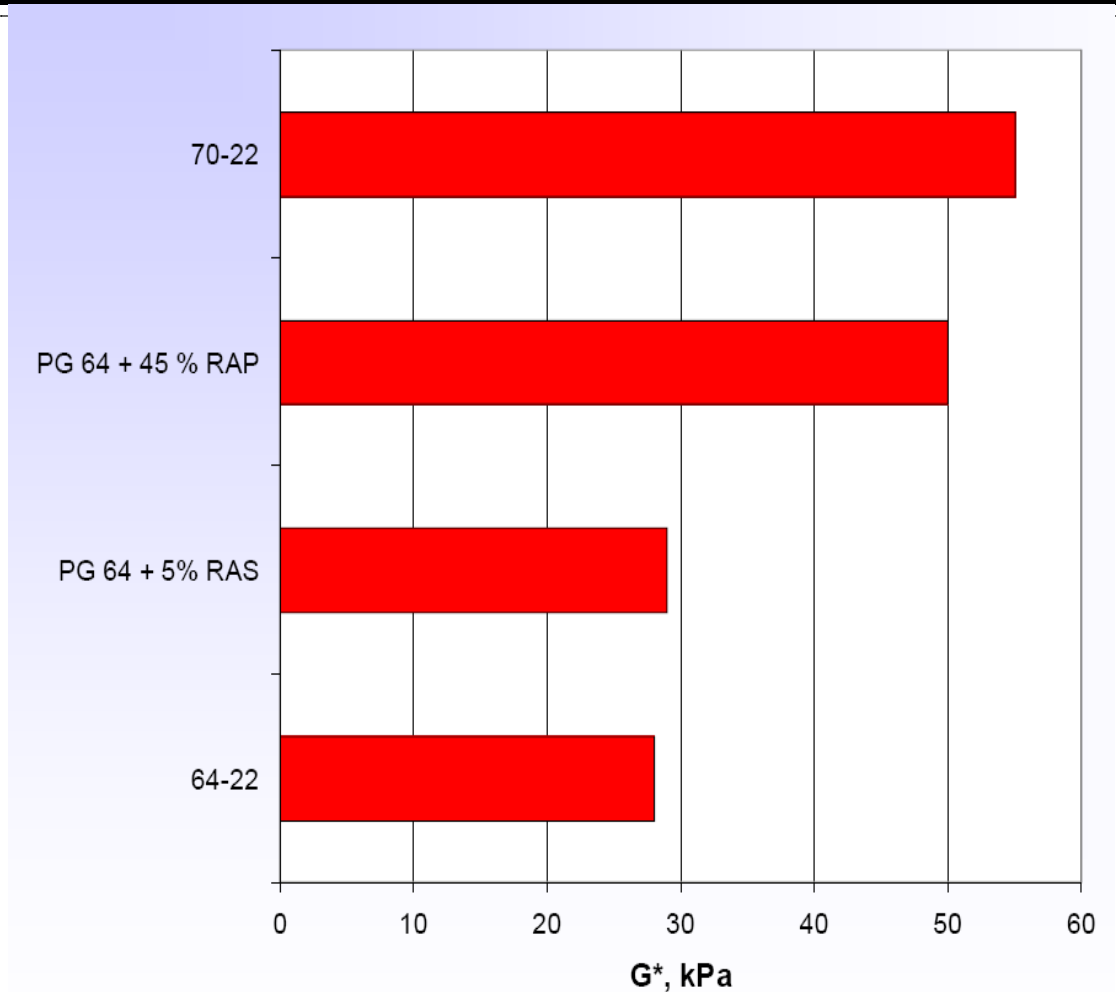
- Recovered binder properties
- Estimated binder properties through mix testing
  - Dynamic modulus testing
  - Very sensitive to binder properties
  - Estimate effective performance grade
  - Hirsch and Witzcak Models
  - Mixture Modulus = f(Binder modulus, VMA, & VFA)

Simple Performance Test

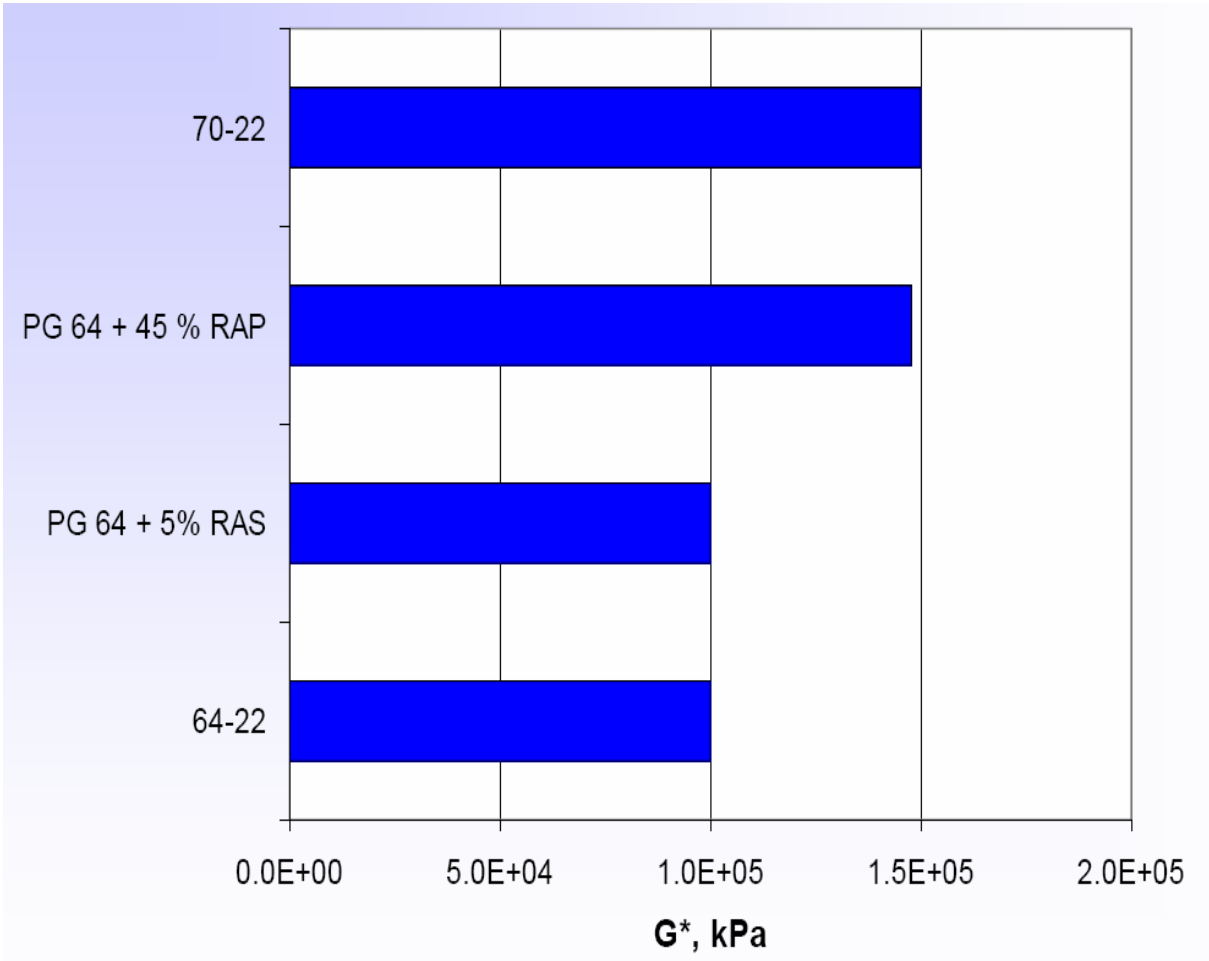
Graphical Representation



High Temperature



Low Temperature



Summary

- The RAS binder contribution to the "mix" performance grade of combined binder can be reasonably estimated
- Warm mix asphalt technology is employing the same approach
- The approach is consistent with future mix performance testing

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HMA Production Considerations

Production Facilities

- Storage of RAS is for a limited time
  - 2-3 weeks
  - Can blend with a sand to extend storage time
- Counter Flow Drum is preferred
- 2nd Recycle Chute is preferred upstream of RAP
- How is liquid asphalt paid for?
  - Separate- need to be able to track added RAS
  - Included in production and placement of HMA

ThankYou!