Mix Design for HMA Recycling

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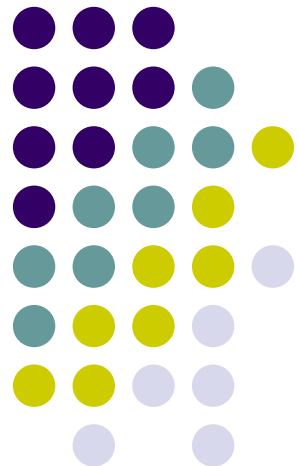
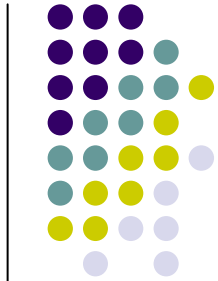


Goals of Recycling



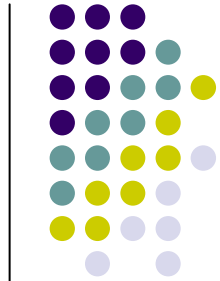
- Reuse a valuable resource
- Avoid a disposal problem
- Save money

- *Produce a recycled mix that performs as well as, or better than, the original mix*

Possible Effects of RAP

- At low RAP contents, there may not be enough old material to significantly affect properties of blend
- At higher RAP contents, the hardened RAP binder may stiffen the mix
  - Good for rutting, not so good for cracking
- The aggregate in the RAP may affect structure and stability of the mix

How can we ensure performance?



- Account for the RAP aggregate and binder in the mix design
  - Adjust design as necessary
  - Tiered system
- Control variability
  - Treat the RAP like another stockpile
  - Practice good stockpile management
  - Process the RAP, if needed

RAP Mix Design Basics

Aggregate Considerations

- Include RAP aggregate in determinations of:
  - Specific gravity
  - Gradation
  - Fine aggregate angularity
  - Coarse aggregate angularity
  - Flat and elongated content

RAP Specific Gravity

- Use RAP agg effective specific gravity, or
- Backcalculate bulk s.g. from Rice density and absorption.

- Agency discretion.

RAP Mix Design Basics

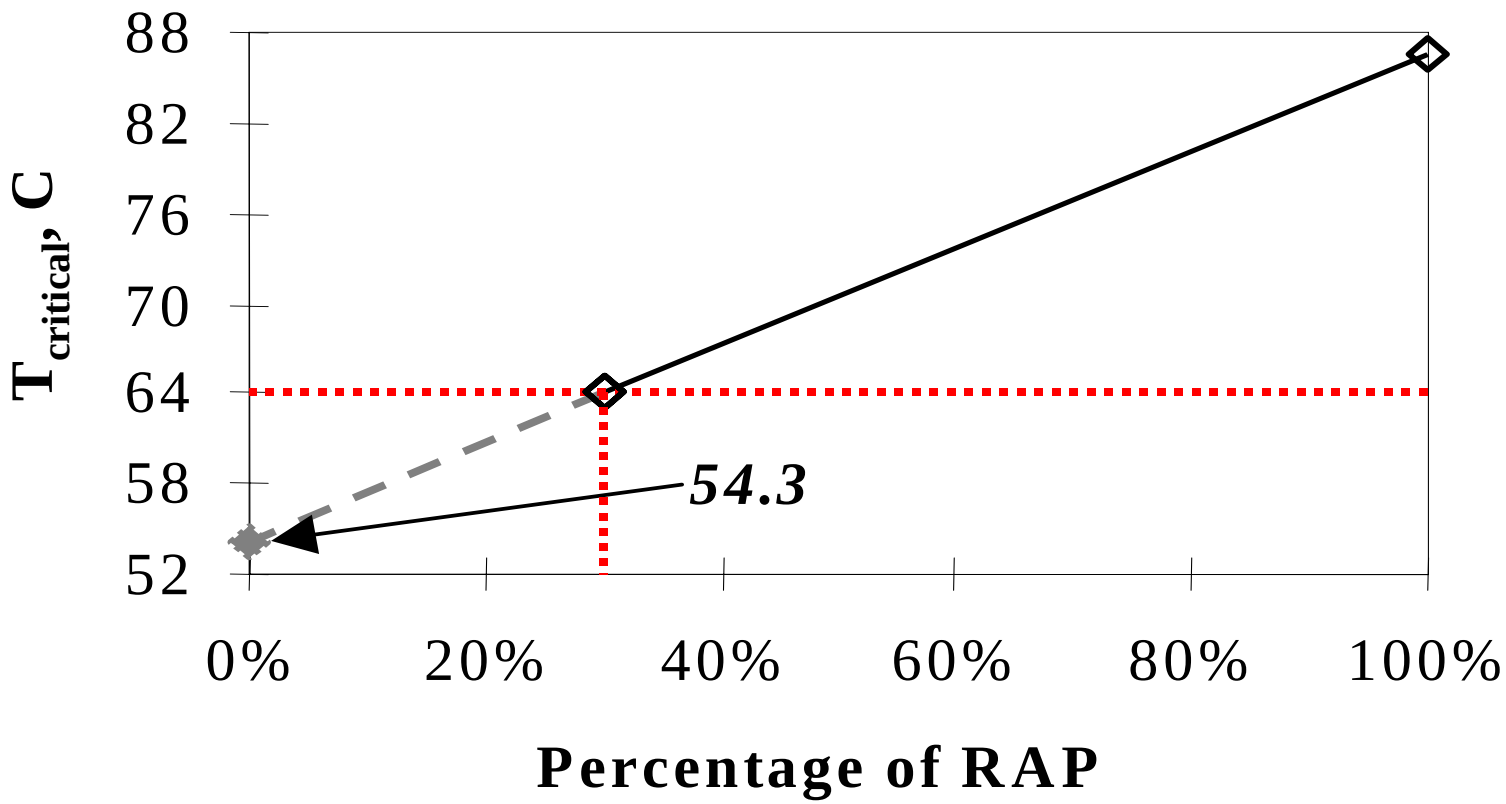
Binder Considerations

- Reduce added binder to account for RAP binder
- For higher RAP contents, use softer virgin binder grade

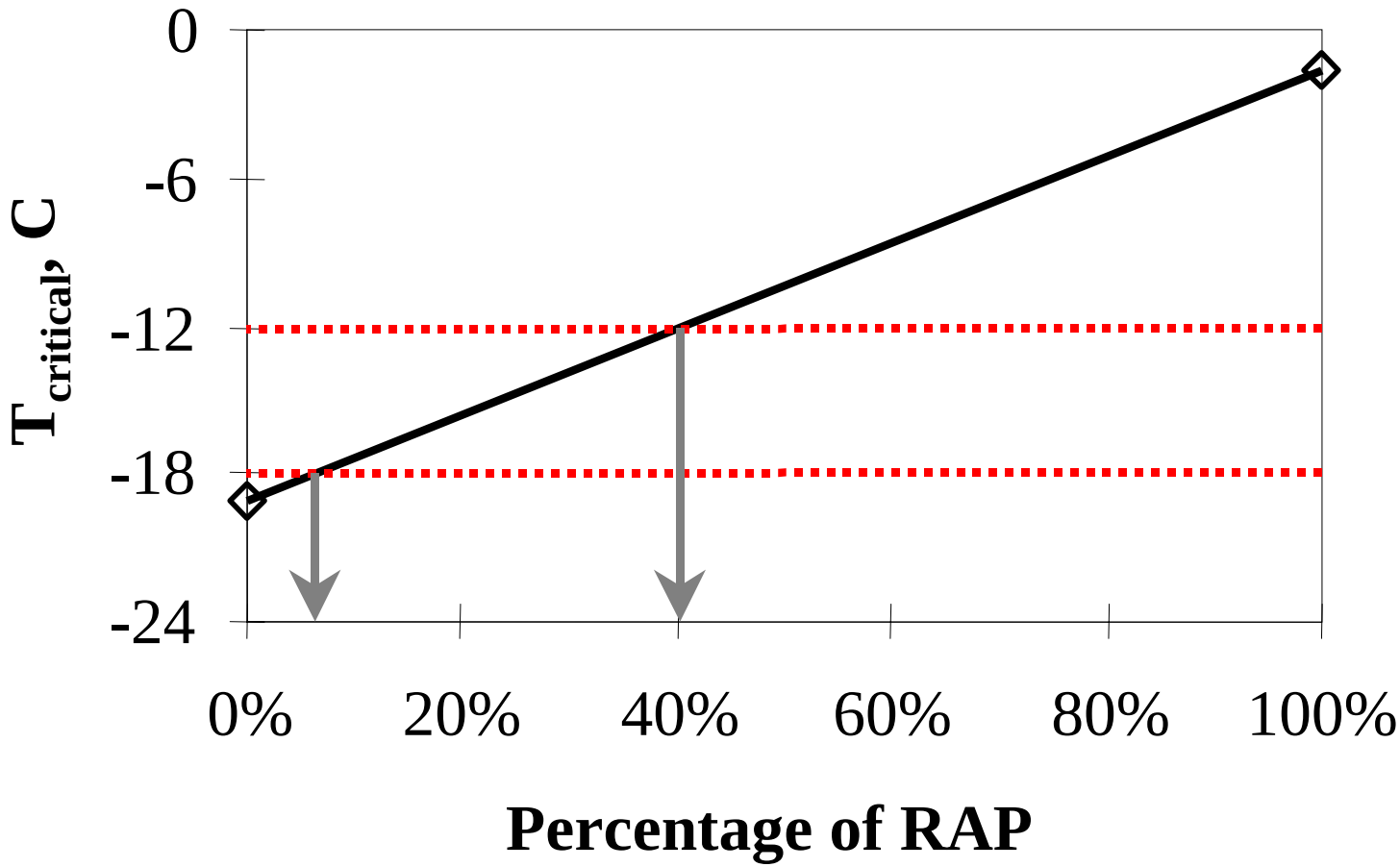
Current Tiers

- Up to 15% RAP, no change in binder grade.
- 16-25% RAP, lower binder grade by one increment.
- More than 25%, create blending charts.
  - Assumes linear blending
  - Extract, recover and test RAP binder
  - High, low and intermediate temperatures

High Temperature Blending Chart, Known RAP Content



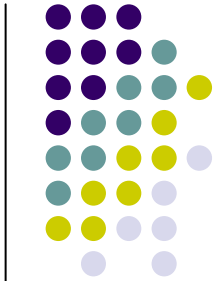
Low Temperature Blending Chart, Known Virgin Binder



Practical Considerations

- Easy to design for 20-25% RAP.
- Above 15% RAP may require soft virgin binders.
  - Cost and construction impacts
- At high RAP contents, gradation and properties of RAP aggregate may limit amount of RAP used.
  - Processing or screening RAP

Practical Considerations

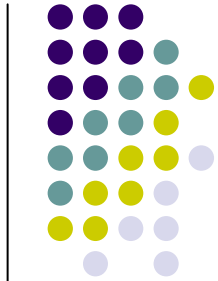


- RAP variability may need to be controlled to meet production tolerances.
- Blending charts and soft binder grades may limit use of high RAP contents unless there are strong economic incentives.

Interest in More RAP Use

- Strong incentives to increase RAP use – mainly economics, environment, supply
  - Use RAP in more mixes (i.e. surfaces)
  - Use higher RAP quantities
- Still barriers to increased use – state specs, variability, performance concerns
- Good news – people are working on overcoming these obstacles.

HMA Recycling ETG



- FHWA initiated in May 2007
- Goals
  - Provide information to help states/industry increase use to current allowable levels
  - Work to increase allowable levels to more than 25%
- Among activities so far:
  - Identification of obstacles to higher use
  - Identification of research needs

Top Ten Research Needs

1. Performance test for evaluating RAP
2. Best practices manual
3. Solventless method to characterize RAP
4. Binder grade changes necessary?
5. Degree of blending of binders
6. Field performance of high RAP mixes
7. Replicating plant heating in lab
8. Guidance for states to allow higher RAP
9. Identification of RAP variability
10. Guidance for processing/fractionating RAP

Research Underway

- NCHRP Project on designing high RAP content mixes
- FHWA funded work on high RAP contents (NCAT/NCSC/UNH)
- RAP in Surface Mixes (NCSC)
- RAP Plant Mix Study (NCSC/HRG)
- State sponsored research across the country
  – WMA with RAP, characterizing RAP

In the Meantime

- Current RAP specifications can be used to produce quality hot mix asphalt.

- RAP mixes can perform as well as, or better than, virgin mixes.

The Future

- High RAP content mixes may become more common.
- Future research may lead to refinements to current system, including new test methods.
- RAP mixes will continue to be valuable, high performing mixtures for widespread use.

More info:

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