

How to get Good Results using RAP in HMA



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Introduction



Introduction

- What is RAP?
- Benefits/ Challenges of using RAP
- Key Performance factors
- Getting Good Results (Performance!)

Why use RAP in HMA?



Environmental impact

Resource conservation
Landfill waste reduction

Economic benefits

Cost savings
Enhance competitiveness

Performance benefits

Consistency
Rut resistance

Starting Point

1970's

RAP usage dates to 1970s

1990

MDOT Standard Spec Book

- 0-15% no AC grade change
- 15-50% may require a AC grade change

Became common practice

1980's

Three tier system introduced

2002

RAP



Question Break!

What factors contribute to limiting RAP use in your county?

- a. RAP inconsistency (gradation / binder)
- b. RAP binder properties (stiffness)
- c. RAP aggregate properties (friction/ toughness)
- d. None

Challenges when using RAP

- Aged Binder stiffness
- Consistency of properties
- Heating & blending RAP
- Availability
- Additional mix design considerations

Key Performance Factors

- Binder grade selection
- RAP percentage
- aggregate quality

Michigan's Problem

Superpave = Dry Mixes

Dry Mixes = Poor Durability

**Does
Superpave = Poor Durability?**

MDOT Strategy to address Cracking

1. Binder Quality

- Tier System

2. Increase Binder Quantity

- Decrease air voids
- Increase VMA

3. Proportions

- Increase V_{be} via gradation

Binder Quality

- Current Special Provisions
 - 501H RAP & RAS in Superpave
 - 501F RAP on Local Agency Projects



Binder Quality - MDOT RAP Tiers



Tier 1:

0-17% RAP binder

No adjustment for RAP binder



Tier 2:

18-27% RAP binder

lower the low end of PG (some exceptions)



Tier 3:

28% + RAP binder

Use blending chart

Tier 3 Opportunity

		Mix Size		
		Base	Leveling	Top
ESAL	Low	✓	✓	✓
	Med-Low	✓	X	X
	Med-High	✓	X	X
	High	✓	X	X

Question Break!

In my experience, mixes are
(_____) produced at the maximum
RAP allowed by specification?

- a. *Always-Often*
- b. *Sometimes*
- c. *Rarely-Never*

Question Results

- MDOT's Answer: **B. Often**
 - Tier 1: Always
 - Tier 2: Always to Often
 - Easy to binder bump
 - Lack of RAP in one region prevents maximization
 - Tier 3: Sometimes
 - Blend chart testing can be cost prohibitive
 - Lack of softer binder for base mixes

Increasing Binder Quantity



Reduced air voids from 4.0% to 3.5%

Resulted in +0.2% binder increase



Air Voids reduced to 3.0%

Another 0.2% binder increase



Fine graded mixtures required

Applied to top and leveling



VMA production target

1% higher than design

Mix Design Strategies

- Superpave considerations by RAP content
 - Low, intermediate, high
- blending charts
- rejuvenators

Blending Charts

Pavement Recycling and Reclaiming Center
Review of High Percentage RAP Usage in Asphalt Concrete

4/5/2013

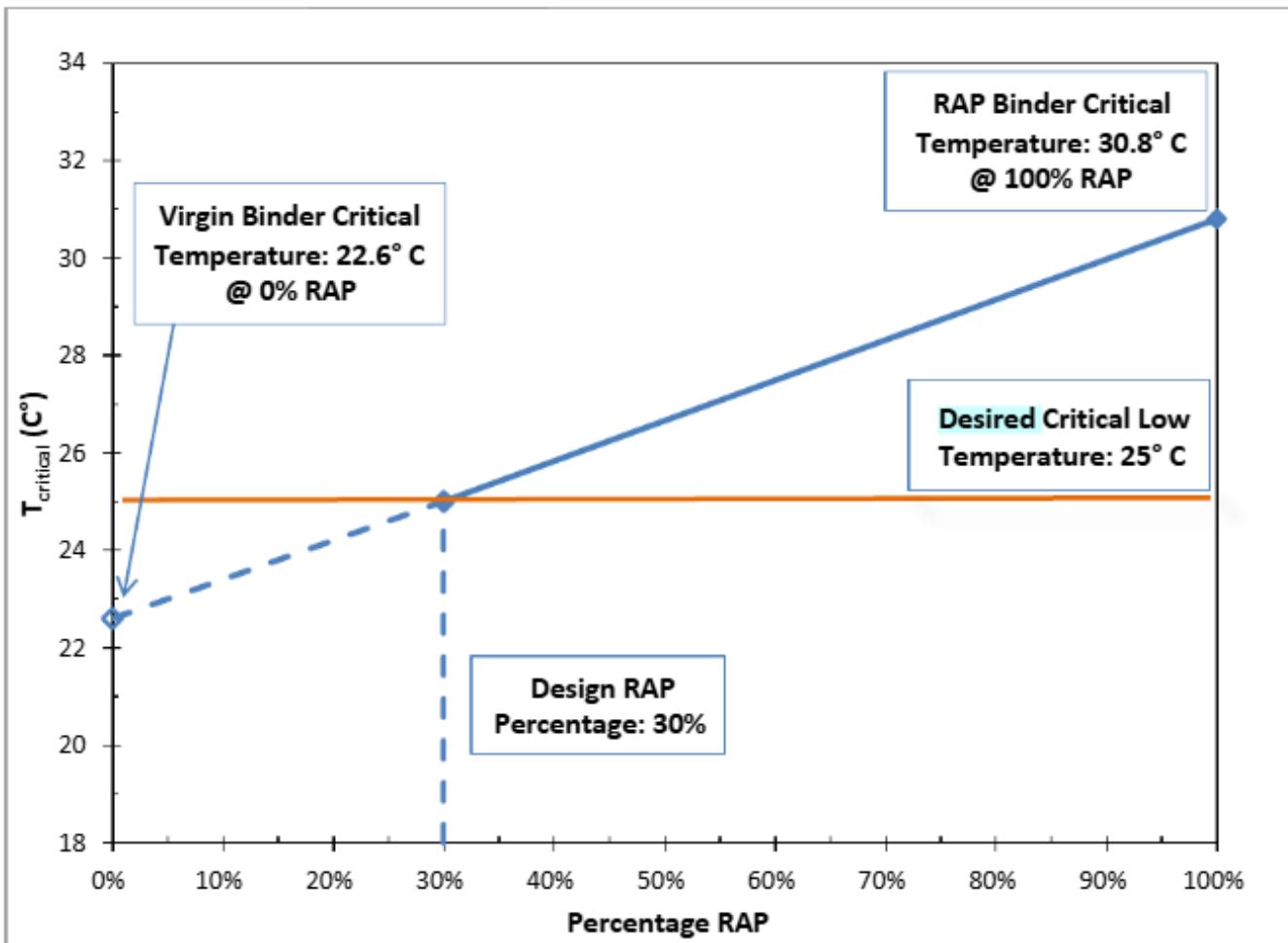
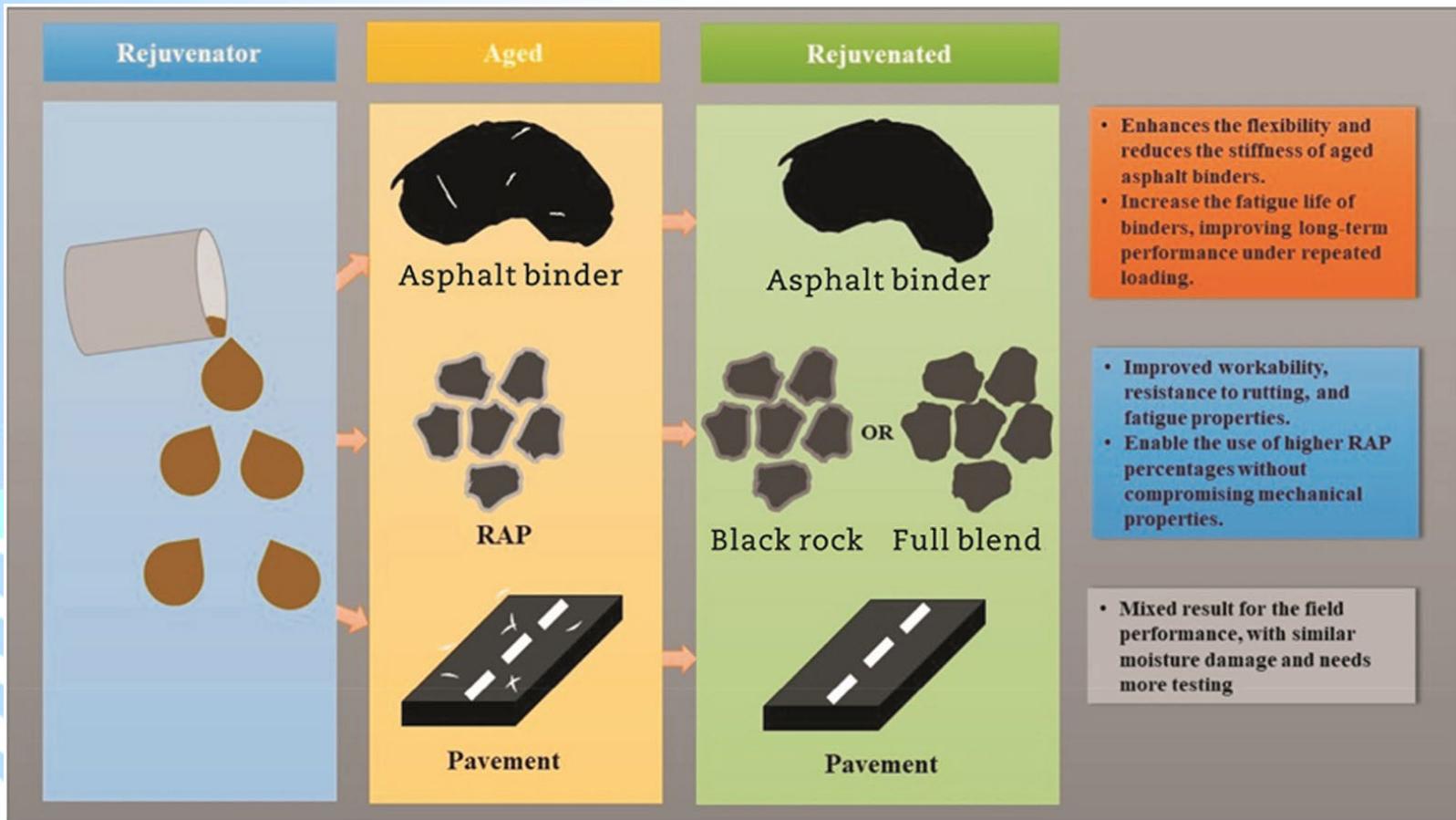


Figure 4-1. Blending chart example

Rejuvenator



Production Best Practices

- RAP management plan
 - Processing
 - Testing frequency
1/1000 ton (min. 3 tests)
 - Moisture control



Production Best Practices

- Plant
 - RAP feed consistency
 - Mixing time
 - temperature control



Performance Expectation

The Expectation:
equivalent (or better) pavement
performance with RAP

Performance Enhancements



ADDITIVES



POLYMERS



BALANCED MIX
DESIGN APPROACH

Outcomes

- Opportunity to increase RAP exists!
 - 25% of surface designs are 30%+ RAP by weight
- RAP levels achieved are lower than specification limits
- Design specific RAP limitations
- Plateau of RAP use

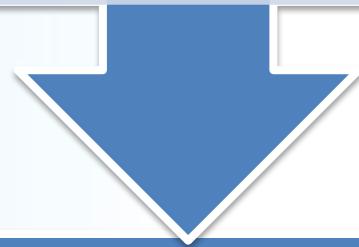
Do I recommend adopting this approach?

This is a Pre-BMD strategy

Rutting –
addressed with
Superpave

Cracking –
addressed with
more/ softer binder

Moisture –
addressed with TSR



**Don't need to wait to
implement**

Considerations

- Not comprehensive, study-based strategy
- Does not include additives options
- Cost
- Not a replacement for mixture performance testing

Summary & Takeaways

Sustainability benefits

Best practices

QC importance

Performance follows



Q & A



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Thank
You!