



# Utilization of RAP

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APRIL 7, 2010  
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# History

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- Many recycled products have been utilized in HMA
  - Glass
  - Used Tires
  - Roofing Shingles
  - Industrial Byproducts



# What is RAP ?

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## Reclaimed Asphalt Pavement

Old asphalt pavement that has been removed from the roadway by either full-depth removal or milling.

# RAP Stockpile







PR-1200

101

44



# RAP Stockpile





# RAP History

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**Our transportation system is costly...But it also represents an investment turned into a savings account...**



# Where does it go?

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- Landfill
- Embankments
- Roadbeds
  - Base and Subbase
  - Shoulder Widening
- New pavement
  - Highest and Best Use



# Roadbeds

Value is roughly equal to granular base







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# Roadbeds

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Value is roughly equal to granular base  
Replacement Value Plus...

\$ Reduced Haul if processed in place

\$ Conservation of aggregate resources

\$ Overall economics (Fuel Consumption & Equip. Savings)

This historically accounted for the largest recycling tonnage





# Shoulders

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Value is greater than granular material +  
increased structural number

\$ Reduced Haul when processed and left in place

\$ Conservation of aggregate resources

\$ Overall economic benefit and less shoulder  
maintenance

\$ Energy savings vs. paved shoulders

\$ Safety of wider shoulder

# Milling pavement



# Millings added to Shoulder





# Finished RAP Shoulder



# RAP Shoulders





# RAP Shoulders





# RAP Shoulders





# RAP in Recycled New Pavement

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**Value = Virgin Aggregate + Asphalt cost**

20% RAP on a 50,000 ton DOT Project

10,000 tons of RAP @ 6.0% Asphalt

➤ 9400 ton Aggregate @ \$20 = \$188,000

➤ 600 tons of Binder @ \$550 = \$330,000

➤ *TOTAL*                      *\$518,000*

➤ *or*                              *\$10.36/project ton*





# RAP in New Pavement: Case Study

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## ***Illinois Tollway Authority (Since 2005)***

- RAP Usage: 1.8 million tons (enough to fill Soldier Field Stadium from top to bottom)
- Asphalt Cement: Saved nearly 4 million barrels of liquid asphalt
- Scrap Tires: Utilized more than 228 thousand for better durability, lower noise levels, and better friction values
- Saved \$10 million, about \$1/ton per 1% RAP usage...15% RAP = \$15 ton savings



# RAP in New Pavement: Case Study

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## ***SDDOT***

- Since expanded use in 2006, RAP: 600k tons
- Asphalt Cement: Saved nearly 36,000 tons of binder
- Saves roughly \$3.5 million/year in Program Cost
- Expecting additional value with WMA



# Issues to Address



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- **Project Planning**

- **Looking at less dollars available!**
- **Larger backlog!**
- **RAP is quality aggregate**
- **Quantities/Binder selection?**
- **Sequence of Work...Mill to Mix**
- **Plan Information (Original Mix Attributes, Original Aggregate Attributes, Original Pavement Thickness)**



# Contractor's

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- **Knowledge = Quality = Profitability**
  - **Experience utilizing RAP**
  - **RAP creates new volumetric issues (VMA and Va areas)**
  - **Virgin aggregate gradation for RAP**
  - **QC/QA properties**



# Mix Issues to Address



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- **Long Term Durability**
  - **Binder properties in Superpave testing system using RAP aggregate**
  - **Use of polymer modified asphalts with RAP**
  - **Use of softer virgin binder grades with RAP**
- **ARE the correct Specifications in place?**



# National Research

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- Numerous Tests at NCAT Test Track & Other Accelerated Testing Sites
- NCHRP 9-12: Incorporation of Reclaimed Asphalt Pavement in the Superpave System
  - Black rock argument
  - Binder grade selection
  - Mixture and pavement performance





# NCHRP 9-12 Conclusions

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- RAP is not just a Black Rock.
- Significant binder blending occurs.
- Significant binder savings will occur.
- Mixtures will perform if sufficient preliminary engineering is conducted.



# RAP + Virgin HMA

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- Equivalent Aggregate Characteristics
- Proper Binder Grade
- Quality Control
- Construction Specifications

# RAP Management

Knowledge of the RAP Quality is essential!

- Binder Quantity
- Binder Grade
- Gradation
- CAA
- FAA
- F&E
- SE







# The Big Question

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How Much RAP Can Be Utilized?

- Specifications
- Existing RAP Properties
- %'s up to 50% are common
- %'s over 50% are being experimented with



# High levels of #200 material

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- Milling RAP generates #200 material
- Fractionating / Crushing generates #200
- #200 may often limit the amount of RAP that may be added to Specification HMA
- Consider mixes or virgin aggregate combinations that can accommodate the high #200

# Steps to minimize excess # 200

- If possible, screen RAP before crushing
  - Less material to crush
  - Creates less dust
- Adjust milling operations
  - Travel speed
  - Milling head speed
  - Depth







# So how much RAP can I add?

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- Depends on the Specifications
- Higher %'s require increased QC
- Preliminary testing and design considerations are necessary
- Pick and choose where to use your RAP

***Knowledge = Quality = Profitability***



# Field Issues

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- Field control of volumetrics
- Consistent RAP
  - Quantity
  - Quality
- Air voids (RAP binder content)
- Field VMA specification
- Inplace density

# The Bottom Line



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## **Reclaimed Asphalt Pavement:**

- 👍 Saves dwindling aggregate resources
- 👍 Recovers non-renewable petrochemical resources
- 👍 Diverts large volumes of materials from overloaded landfills
- 👍 Reduces road building costs
- 👍 Available close to the market
  - reduces trucking